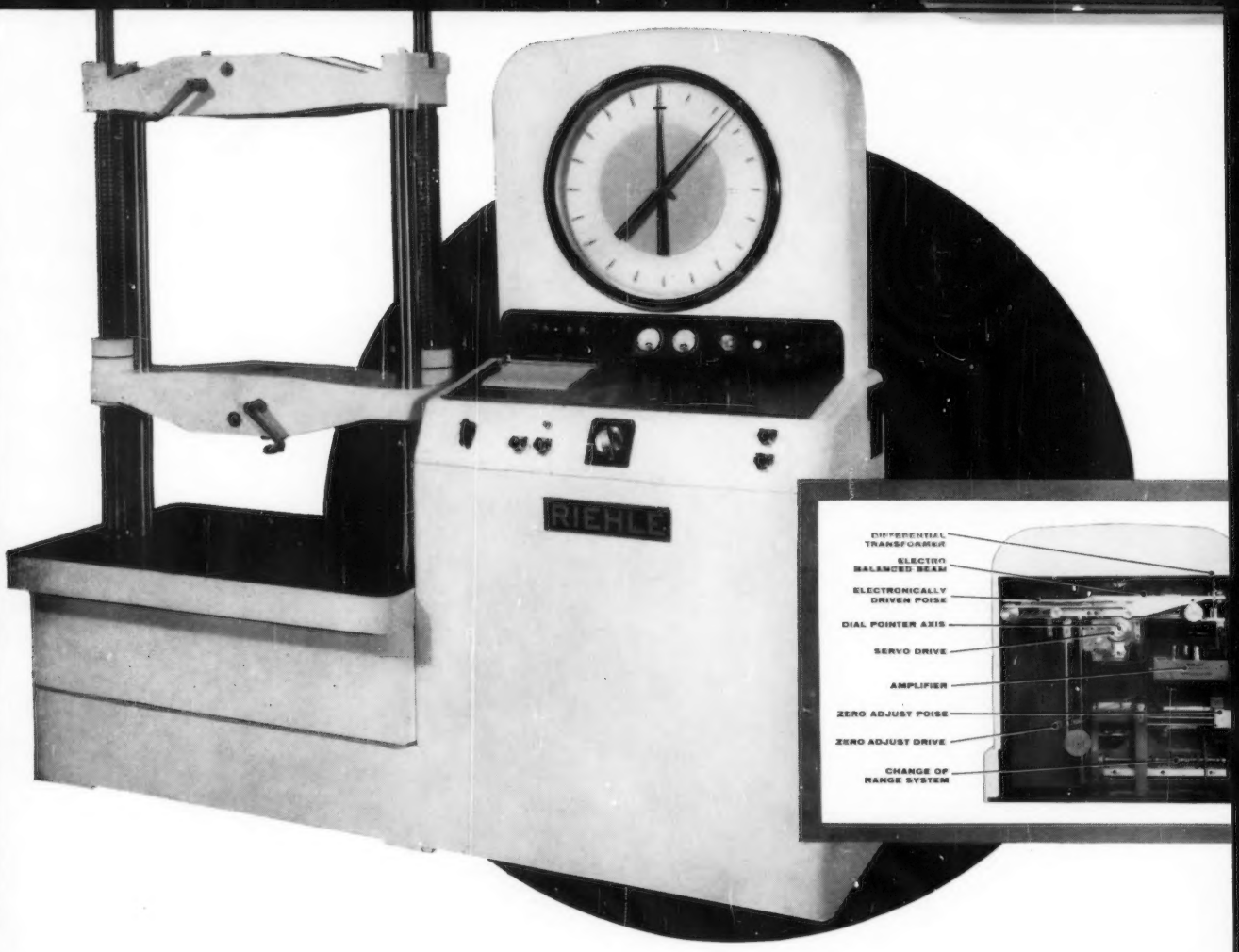
APRIL, 1957
No. 221

ASTM Bulletin

PROVISIONAL PROGRAM
60th Annual Meeting
Atlantic City, N. J.
June 17–21

American Society for Testing Materials



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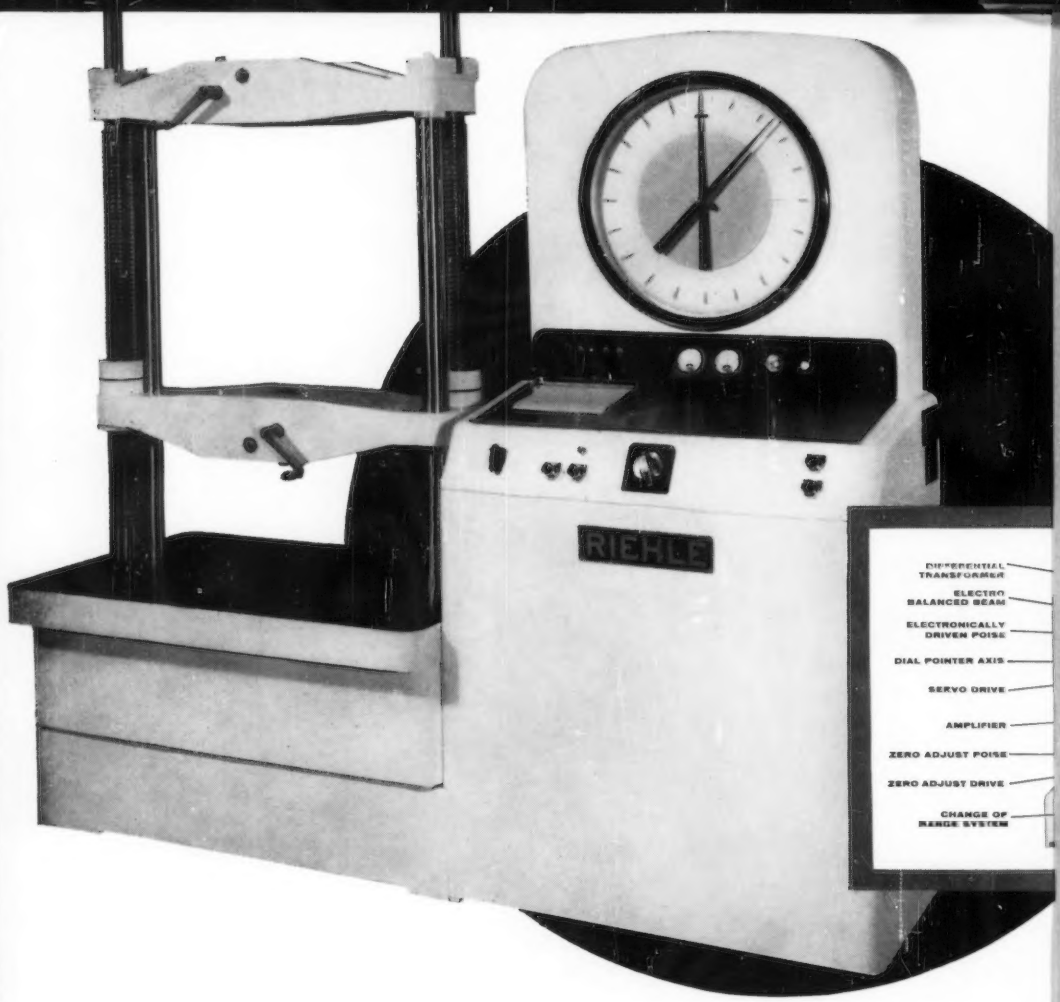
APRIL 1957

Number 221

Telephone: Rittenhouse 6-5315 Cable Address: Testing, Philadelphia

ASTM Bulletin is indexed regularly by Engineering Index, Inc.
ASTM Bulletin is available on microfilm from University Microfilms, Ann Arbor Mich.

ASTM Bulletin, April 1957. Published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, $2.75, two years, $4.75, three years, $6.50; Canada, one year, $3.25; two years, $5.75, three years, $8.00. Other countries, one year, $3.75; two years, $6.75; three years, $9.50. Single Copies—50 cents. Number 221. Entered as second class matter, April 8, 1940, at the post office at Easton, Pa., under the act of March 3, 1879.



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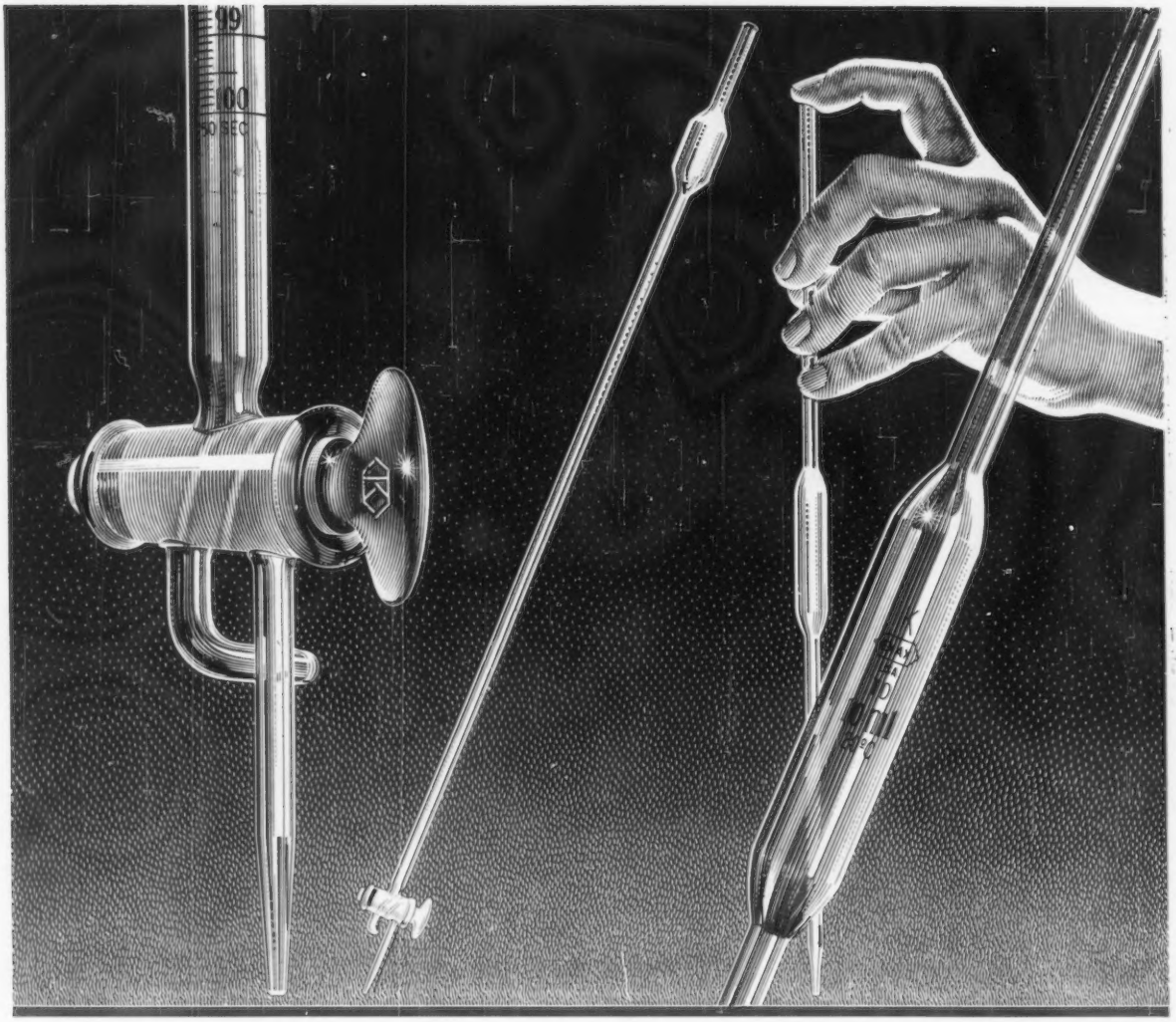

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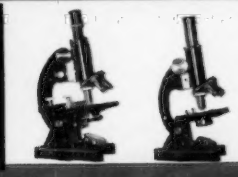

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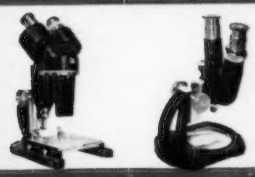

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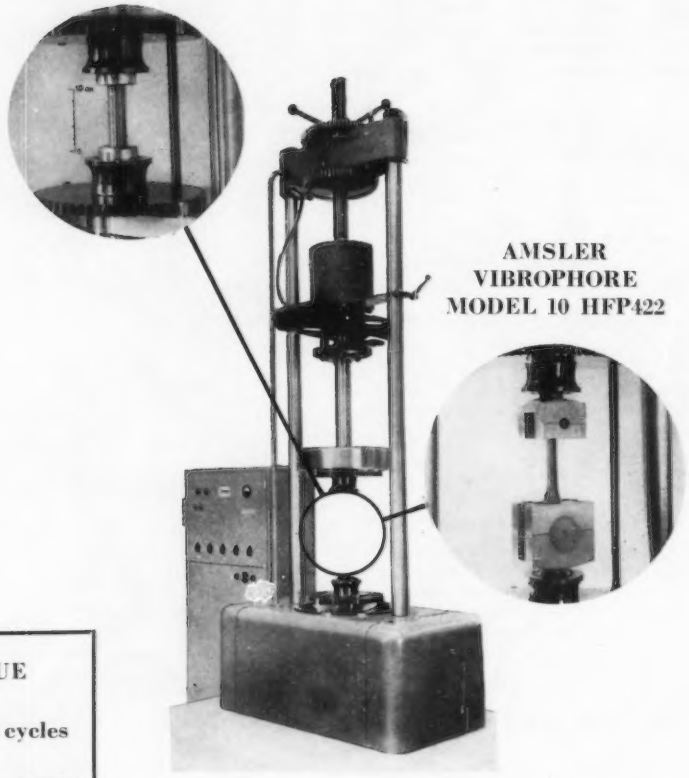

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 221 April 1957

60th Annual Meeting

Offers 32 Sessions on 13 Widely Varied Fields of Materials Technology

Atlantic City, N. J. June 17—21

ROUNDING out six decades of ASTM assemblies, the 60th Annual Meeting of the Society which will be held in Atlantic City the week of June 17, maintains the high standard of technical quality associated with these meetings and promotes investigation into the new areas of materials technology opening up through the development of new forms of energy and power plants.

The 32 technical sessions will include five symposia:

- Determination of Gases in Metals
- Large Fatigue Testing Machines and Their Results
- Spectrochemical Analysis for Trace Elements
- Radiation Effects on Materials
- Determination of Dissolved Oxygen in Water

Sessions of equally authoritative papers will be held on the subjects of:

- Miscellaneous Testing
- Soils
- High Temperature
- Masonry
- Steel
- Fatigue
- Concrete
- Non-Ferrous Metals

Lectures on Molybdenum and Water

Two outstanding features of the technical program are the memorial lectures honoring Edgar Marburg, first Secretary of the Society, and Horace W. Gillett, one of America's leading metallurgists.

The Marburg Lecture will be given by Everett P. Partridge, director of Hall Laboratories, Pittsburgh, Pa., on a subject that is assuming ever increasing importance—industrial water.

The Gillett Lecture—always on the subject of metals—will be presented by Alvin J. Herzig, president of Climax Molybdenum Co. of Michigan. The title of his lecture is "A Perspective of Molybdenum Base Alloys." (For further information on the lecturers and the scope of their papers, please turn to page 8.)

Committee Meetings

Forty-seven of the Society's technical committees are scheduled to meet in Atlantic City. A detailed listing of the main committee and subcommittee meetings will be included in the program given to registrants. An advance tentative outline of these committee meetings was included in the April 1 letter to members transmitting hotel reservation forms. As was pointed out in the letter, members should consider this schedule as tentative, to be superseded by the call of meetings by committee officers; in other words, *the official notice for committee and subcommittee meetings will be received directly from the Secretary of each committee.* As this issue goes to press, the committee schedule appears as follows:

A-1	Steel—Monday, Tuesday, Wednesday
A-2	Wrought Iron—Tuesday
A-3	Cast Iron—Thursday, Friday
A-5	Corrosion of Iron and Steel—Thursday, Friday
A-6	Magnetic Properties—Friday
A-7	Malleable-Iron Castings—Tuesday
A-9	Ferro Alloys—Tuesday
A-10	Iron-Chromium, Iron-Chromium-Nickel and Related Alloys—Wednesday, Thursday
B-2	Non-Ferrous Metals and Alloys—Monday, Tuesday, Wednesday
B-3	Corrosion of Non-Ferrous Metals and Alloys—Wednesday
B-4	Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts—Thursday, Friday

THE PROVISIONAL PROGRAM . . .

of the 60th Annual Meeting which begins on page 9 is designed to give you a comprehensive preview of the symposia, sessions, and special events of the meeting. You will find brief abstracts of the papers which will be presented and statements of the scopes of the symposia.

The official program which registrants will receive at the meeting will contain full and final details of the session, a complete schedule of committee meetings, and the when and where of entertainment features of the week.

This air view of Atlantic City shows the Boardwalk hotels that are co-
10. Shelburne 9. Dennis 8. Claridge 7. Senator 6. Seaside

B-6	Die-Cast Metals and Alloys—Tuesday, Wednesday	D-4	Road and Paving Materials—Wednesday, Thursday, Friday	E-2	Emission Spectroscopy—Wednesday, Thursday
B-7	Light Metals and Alloys, Cast and Wrought—Monday, Tuesday	D-5	Coal and Coke—Monday, Tuesday, Wednesday, Thursday	E-3	Chemical Analysis of Metals—Monday, Tuesday, Wednesday
C-1	Cement—Wednesday, Thursday, Friday	D-6	Paper and Paper Products—Thursday, Friday	E-4	Metallography—Monday,Tuesday, Wednesday
C-2	Magnesium Oxychloride and Magnesium Oxysulfate Cements—Monday	D-8	Bituminous Waterproofing and Roofing Materials—Monday, Tuesday, Wednesday	E-7	Nondestructive Testing—Monday, Tuesday, Wednesday, Thursday
C-4	Clay Pipe—Monday, Tuesday	D-9	Electrical Insulating Materials—Wednesday, Thursday, Friday	E-9	Fatigue—Monday, Tuesday
C-7	Lime—Monday, Tuesday	D-11	Rubber and Rubber-Like Materials—Monday, Tuesday, Wednesday	E-10	Radioisotopes and Radiation Effects—Wednesday
C-9	Concrete and Concrete Aggregates—Monday, Tuesday, Wednesday	D-16	Industrial Aromatic Hydrocarbons and Related Materials—Friday	E-11	Quality Control—Sub I ASTM Problems—Monday
C-11	Gypsum—Thursday, Friday	D-17	Naval Stores—Thursday	E-12	Appearance—Monday
C-12	Mortars for Unit Masonry—Wednesday, Thursday	D-18	Soils for Engineering Purposes—Monday, Tuesday, Wednesday		
C-15	Manufactured Masonry Units—Thursday, Friday	D-19	Industrial Water—Wednesday, Thursday, Friday		
C-17	Asbestos-Cement Products—Monday	D-20	Plastics—Monday, Tuesday, Wednesday		
C-23	Sorptive Mineral Materials—Thursday	D-24	Carbon Black—Thursday		
D-1	Paint, Varnish, Lacquer, and Related Products—Monday, Tuesday, Wednesday	D-25	Casein and Similar Protein Materials—Wednesday		
D-2	Petroleum Products and Lubricants—Monday, Tuesday Wednesday, Thursday, Friday	E-1	Methods of Testing subcommittees—Monday, Tuesday, Wednesday, Thursday		

Preprints of Papers and Reports

To stimulate discussion and its resultant cross-fertilization of ideas, preprints of papers are made available prior to the meeting. Similarly, reports are preprinted so that members will be informed concerning standards actions that are being recommended by the technical committees. Each member should by now have received the preprint request blank which was mailed on April 12. The first installment of

operating with the Annual Meeting Headquarters Hotel, Chalfonte Haddon Hall.
5. Morton 4. Colton Manor 3 Lafayette 2. Chalfonte 1. Haddon Hall

preprints should go in the mails to those requesting them about May 10. The second and third installments will be mailed on May 29 and June 14, respectively.

Registrants at the meeting will have another opportunity to secure preprints of the papers and reports.

Luncheons and Special Events

A streamlined Presidents' Luncheon will be held this year, featuring the President's Address by R. A. Schatzel, the Report of the Board of Directors, introduction of incoming officers, and recognition of 50-year members.

Presentation of awards, formerly a part of the President's Luncheon, will be made at a separate luncheon on Wednesday. These will include awards to individuals who have given distinguished service to the ASTM along technical lines; and awards established by committees to men of outstanding achievement or leadership in their respective areas of work.

A five-day program of varied entertainment and events will be available to the ladies who accompany their husbands to the meeting. One regular event will be the Annual Dinner which will be preceded by a cocktail party and followed by a floor show and dancing. This event is strictly social, a distinct break in the hard-working atmosphere of an ASTM meeting.

Hotel Reservations

All sessions will be held at the headquarters hotel, Chalfonte-Haddon Hall. A large number of sleeping rooms have been set aside there which space is augmented by blocks of rooms being reserved at the nearby Colton Manor, Lafayette, Morton, Senator and Seaside Hotels. The Claridge, Dennis, and Shelburne, other boardwalk hotels, a few blocks below Chalfonte-Haddon Hall have also made rooms available to ASTM.

Individuals who have not yet returned their hotel reservation forms are urged to do so immediately. May 15 is the limiting date the hotels have given for making reservations.

LADIES' EVENTS IN BRIEF . . .

Coffee Hours
Monday through Thursday 9–10:30 a.m.

Hospitality Tea
Monday at 4:30

President's Luncheon
Tuesday noon

Boat Trip
Wednesday morning

Awards Luncheon
Wednesday noon

Annual Dinner and Dance
Wednesday evening

Luncheon
Thursday noon

EDGAR MARBURG LECTURE

Your Most Important Raw Material—Water by Everett P. Partridge

THE MARBURG LECTURER . . .

Everett P. Partridge has been working to prevent the troubles caused by water ever since he was graduated from Syracuse University in 1925 and set out for the University of Michigan, where he spent the next three years as Detroit Edison Fellow in Chemical Engineering. From this came the degree of Ph.D.

From 1928 to 1931 he served as associate editor of *Industrial and Engineering Chemistry*, then became supervising engineer of a station of the Bureau of Mines at that time maintained in cooperation with Rutgers University. While there, he was in charge of the investigation sponsored by the Joint Research Committee on Boiler Feedwater Studies to seek improved chemical means for preventing embrittlement of steel by boiler water.

In 1935 he was invited to join Hall Laboratories as director of research. While devoting most of his efforts to the development of new applications for complex sodium phosphates in the process industries, he also developed the concept of steam blanketing to explain some peculiar cases of internal attack in boiler tubes. Upon the retirement of Dr. Hall in 1950, Dr. Partridge became director.

Dr. Partridge is a past chairman and currently finance chairman of the Joint Research Committee on Boiler Feedwater Studies; a member of the Research Executive Committee of the ASME; the Subcommittee on Care of Power Boilers of the ASME Boiler Code Committee; ASTM Committee D-19 on Industrial Water, NACE Committee T-3F on High Purity Water and the Inter Society Corrosion Committee.

In 1955, Dr. Partridge received the Max Hecht Award of ASTM Committee D-19 for outstanding service in the study of water as an engineering material.

THE LECTURE . . .

Water is as basic to industry as it is to life itself. Short in supply in various parts of the United States, water actually is plentiful over the country as a whole. Unlike our rapidly decreasing resources of minerals and fossil fuels, fresh water is supplied to us year after year as rain and snow at a rate approximately seven times our total use. Our problem is to catch it, store it, and transport it to the regions where we need it. Then we must use and re-use it efficiently.

Like most raw materials, water is contaminated with various substances that cause trouble. Some of these impurities are the natural result of flow over or through the surface of the earth. More and more, however, the wastes from our human activities have complicated the re-use of water.

What must be done to prepare water for industry depends on the way it is to be used. Ultra-pure water containing no more than 50 parts per billion of total impurities may be specified for a once-through boiler, while the effluent from a municipal sewage plant serves satisfactorily for cooling equipment in a great steel mill.

HORACE W. GILLETT LECTURE

A Perspective of Molybdenum Base Alloys by Alvin J. Herzig

THE GILLETT LECTURER . . .

Alvin J. Herzig, a native of Toledo, Ohio, was graduated from the University of Michigan with a B.S. in Chemical Engineering in 1926. After two years in industry where he began his specialization in physical metallurgy, he returned to his alma mater to conduct research on brass for the Utilities Research Commission and to work toward an advanced degree. In 1931 his continuing association with Climax Molybdenum Co. began when he was employed as chief metallurgist to set up and conduct experiments in the use of molybdenum in steel and cast iron. Mr. Herzig was subsequently made vice-president in charge of laboratory and in 1949 was named president of Climax Molybdenum Co. of Michigan. The parent company, Climax Molybdenum, gave him the title vice-president—research in 1954.

Mr. Herzig has served the Government in the Materials Advisory Board of the National Research Council as a member of the executive committee of the Engineering and Industrial Research Div., and as American Society for Metals representative to that group.

His professional affiliations, in addition to ASTM and ASM, include, American Institute of Mining and Metallurgical Engineers, Society of Automotive Engineers, Society for Experimental Stress Analysis, and the British Institute of Metals.

THE LECTURE . . .

The potential of molybdenum as an alloy-base metal has been in development since the beginning of the century. Because of its high-melting point, it was extremely difficult for many years to obtain the elemental metal in section sizes which would make it attractive as an engineering material. By the 1930's through development of powder metallurgy processing, a small but significant application of molybdenum in the electronics field had been established. The knowledge of the metal thus gained provided impetus for the investigation of methods to produce larger sections of molybdenum when in the early 1940's it became apparent that our developing technology would require super high-strength materials in the future. The development of a commercially feasible vacuum arc-casting process by the late 1940's made it desirable to re-examine the potential strength of the system of molybdenum-base alloys.

In this lecture, the author attempts to give a perspective of the broad subject not only by reciting some of the properties which have already been achieved in molybdenum-base alloys but also by speculation in some of the areas where complex, technical problems still remain. One of the several furnaces now being employed to obtain aggregates of molybdenum by melting rather than by the powder metallurgy processes is described in some detail. Those attending the lecture will have an opportunity to see a short motion picture of the action at the molten metal surface during the production of a 1000-lb ingot of molybdenum.

◊ *This Program is subject to change*

PROVISIONAL PROGRAM

Sixtieth Annual Meeting

AMERICAN SOCIETY FOR TESTING MATERIALS

ATLANTIC CITY, N. J. • JUNE 17-21, 1957

All time indicated is Eastern Daylight Saving Time

Committee Meetings held throughout the week

MONDAY, June 17	TUESDAY, June 18	WEDNESDAY, June 19	THURSDAY, June 20	FRIDAY, June 21
MORNING				
—10:30 a.m.—				—10:30 a.m.—
1 Opening Session—General Testing (Report Committee E-1)	**7 Symposium on Determination of Gases in Metals**	**17 High Temperature Session**	**24 Symposium on Radiation Effects on Materials**	**30 Masonry Session**
	8 Symposium on Large Fatigue Testing Machines and Their Results	—11:15 a.m.— **18 Report Session** (Reports C-7, C-9, C-13, D-8, D-18, E-5, E-6)	—11:30 a.m.— **25 Report Session** (Reports C-3, C-8, C-12, C-14, C-16, C-21, C-22)	
	—12:00 noon— **9 Luncheon Session, President's Address**	—12:00 noon— **19 Luncheon Session, Awards, Medals**		
AFTERNOON				
2 Soils Session	**10 Symposium on Large Fatigue Testing Machines and Their Results**	—2:30 p.m.— **20 High Temperature Session**	**26 Symposium on Radiation Effects on Materials**	—12:30 p.m.— **31 Report Session** (Reports A-3, A-5, A-6, B-4, C-1, C-11, Adv. Comm. Corrosion)
—4:30 p.m.— **3 Report Session** (Reports C-2, C-17, D-13, D-22, D-23, E-12)	**11 Symposium on Spectrochemical Analysis for Trace Elements**	—4:00 p.m.— **21 Report Session** (Reports B-1, B-2, B-3, B-5, B-6, B-8, B-9)	—4:30 p.m.— **27 Report Session** (Reports A-10, E-2, E-7, E-13)	—12:30 p.m.— **32 Report Session** (Reports D-2, D-3, D-4, D-6, D-9, D-15, D-16, D-19, F-1)
	—4:30 p.m.— **12 Report Session** (Reports A-1, A-9, B-7, E-9, E-11, Jt. Comm. Effect Temp., Jt. Comm. Leather)	—4:00 p.m.— **22 Report Session** (Reports D-1, D-11, D-14, D-20, D-25, E-3)	—4:30 p.m.— **28 Report Session** (Reports D-5, D-7, D-12, D-17, D-21, D-24)	
	—5:00 p.m.— **13 Gillett Lecture A. J. Herzig Molybdenum**	—4:30 p.m.— **23 Marburg Lecture, E. P. Partridge Water**		
EVENING				
4 Steel Session **5 Fatigue Session** **6 Concrete Session**	**14 Symposium on Spectrochemical Analysis for Trace Elements** **15 Non Ferrous Metals Session** **16 Concrete Session**	**Cocktail Party** **ASTM Dinner** **Entertainment** **Dancing**	**29 Symposium on Determination of Dissolved Oxygen in Water**	

NOTE.—It is possible that some of the papers listed in the following provisional program will be presented by title only. Consult the final program for this information.

Monday, June 17 10:00 a.m. First Session

Opening Session

Formal Opening of the Sixtieth Annual Meeting. President R. A. Schatzel

General Testing Session

Autographic Stress-Strain Recorders. R. R. Bouche and D. R. Tate, National Bureau of Standards.

Autographic stress-strain recorders of many different designs have been applied to the testing of materials. A survey of the characteristics and limitations of these instruments, covers the more important developments up to the present time. As there was little published information on their accuracy an investigation was conducted at the National Bureau of Standards on three recorders and extensometers typical of some 2000 recorders in use in this country for the testing of metallic materials. It was found that the accuracy of the strain coordinates of the three recorders tested conforms quite well with the requirements for Class B extensometers described in ASTM Specification E 83.

Determination of Strain-Hardening Characteristics by Torsion Testing. D. S. Fields, Jr., Aluminum Company of America and W. A. Backofen, Massachusetts Institute of Technology.

Analytical considerations are presented and experimental techniques described which allow a determination of strain-hardening characteristics by torsion testing. The conventional analysis of plastic torsion in a cylindrical specimen has been generalized to include rate-sensitive materials. Methods are deduced by which stress, strain, strain-rate relationships may be obtained from the fewest possible specimens with a minimum amount of graphical construction. The methods have been found to yield results identical with those obtained by other techniques.

An Evaluation of Geiger Counter X-Ray Techniques for Measuring Stresses in Hardened Steel. Karl E. Beu, Goodyear Atomic Corp. (To be presented by title only)

A "two exposure" X-ray Geiger counter technique for measuring residual and applied stresses originally described by Christenson and Rowland is discussed. A comparison of results published by other observers using similar techniques is also discussed and evaluated. Experimental and theoretical evidence is offered to demonstrate that the method described by Christenson and Rowland is useful for making absolute stress measurements with an accuracy of about ±10,000 psi and a reproducibility of about ±5000 psi on steels in the hardness range of 25 to 62 Rockwell C. To date, this method has been found to be the only reliable one for measuring stresses in hardened steels by X-rays.

Nondestructive Technique for Macro and Micrographic Surface Examination of Metallic Specimens (English Translation). A. Jacquet, Laboratory of the French Navy.

Phase Nomenclature for Metallic Systems. P. A. Beck, University of Illinois.

Phase nomenclature for metallic systems has been developed by the membership of Subcommittee III of Committee E-4 on Metallography to fill a great need for international unification. The subcommittee personnel includes numerous European metallurgists. This has been a long range program begun about ten years ago. The author will describe the system which has received general acceptance.

Constant Strain-Rate Testing Machine with Instantaneous Speed Change. M. J. Manjoine, E. T. Wessel, and W. H. Pryle, Westinghouse Electric Corp.

In the study of the flow and fracture of metals the influence of rate of strain is paramount. To obtain quantitative data on the strain rate effect, it is desirable to change the rate instantaneously to several values that are usually different by an order of magnitude. In this machine an electrical-mechanical drive allows instantaneous speed changes as large as 1 to 1,000,000 with and without intermediate steps. The speed can also be continuously changed as a function of time or strain over a range of 1 to 100,000.

The Significance of Test Results from Small Groups of Specimens. E. H. Schuette, The Dow Chemical Co.

A method is presented for defining the significance, in terms of both confidence levels and expected exceedances, of the lowest results obtained from small sample groups of equal size. The method is then extended to apply as well to the second and higher ranking results. The method is independent of the distribution form of the population sampled. A table gives plotting positions on probability paper, permitting interpolation of expected exceedance at any given confidence level.

Report of Committee E-1. J. R. Townsend, Chairman.

Monday, June 17 2:00 p.m. Second Session

Session on Soils

Analysis of Bearing Capacity and Settlement of Footings on Cohesionless Sands. B. Mazanti and G. F. Sowers, Georgia Institute of Technology.

The design of spread footings on cohesionless sands is now based either on the results of plate load tests, or on theoretical formulas, or on semiempirical methods based on experience. Unfortunately none of these are satisfactory. Interpretation of the plate load test is based largely on tradition; the theoretical analyses are not always confirmed by performance; and the semiempirical methods appear over-conservative. Tests of small sized footings on sand at Georgia Institute of Technology have led to the development of methods for interpreting load tests rationally and to the correlation of theoretical analyses with actual foundation performance. This paper describes the tests and the methods of analysis developed.

The Use of a Field Vane Apparatus in Sensitive Clay. W. J. Eden and J. J. Hamilton, National Research Council of Canada.

The extremely sensitive deposits of postglacial marine clay in the St. Lawrence lowlands have presented major difficulties in obtaining adequate undisturbed samples for a reliable determination of shear strength. To overcome this problem, a simple field vane apparatus was devised which was readily adaptable to existing drilling equipment. This paper describes the apparatus and outlines the method of testing which has been used in the field. Data comparing shear strength values obtained with vane with those obtained from tube samples are given for several test holes in the clay. In addition, the influence of such factors as the area ratio of the vane, and rod friction are discussed along with its use as a measure of sensitivity. It is concluded that the field vane device offers a more reliable criterion for shear strength of the clay than determinations made from tube samples. Advantages and restrictions on its use are also considered.

Fundamental Relationships Between the Porosity, Density and Permeability of Soils. W. E. Schmid, Princeton University.

The complex problem of determining the influence of different variables on the permeability of soils is investigated by establishing a working model which allows the derivation of a theoretical expression for the permeability. Results of tests conducted by the author and several other investigators are used to show the general validity of the derived expression. A discussion follows giving theoretical as well as experimental evidence why some still widely used concepts regarding the relationship between void ratio and permeability cannot be valid and the limits of validity of the proposed expressions are investigated.

Soil Stabilization by Chemical Grouting. R. H. Karol, American Cyanamid Co.

Quick conditions encountered during excavation work are a tremendous problem to contractors. Much time, effort, and money are spent in attempting to alleviate flow of water, carrying soil with it. Chemical grouting is one of the methods by which quick conditions may be controlled. The author discusses characteristics which would be desirable for any chemical grout, and the properties of one such chemical, American Cyanamid Co.'s Stabilizer AM-955. The results of laboratory and field research to evaluate the properties of stabilized soil are described. Field equipment and one or two successful field applications are detailed.

Design and Deflection Control of Buried Steel Pipe Supporting Earth Loads and Live Loads. Russell Barnard, Armco Drainage & Metal Products, Inc.

Monday, June 17 2:00 p.m.

Papers on Statistical Aspects of ASTM Specifications

Under auspices of Committee E-11 on Quality Control, H. F. Dodge, Chairman, O. P. Beckwith, Secretary.
Sponsored by Subcommittee I on ASTM Problems. W. R. Pabst, Chairman.

This session has been arranged in order to provide an opportunity for members of the Society and particularly of the technical committees to discuss their mutual problems in the field of statistical analysis and quality control techniques. To initiate the discussion the following three papers will be presented:

Planning Inter-Laboratory Tests. Grant Wernimont, Eastman Kodak Co.

Selecting the More Sensitive Test Method. John Mandel, National Bureau of Standards

Review of the E-11 Program. Oliver P. Beckwith, William Carter Co.

Monday, June 17 4:30 p.m. Third Session

Committee Report Session

C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements. E. S. Newman, Chairman.
C-17 on Asbestos-Cement Products. W. V. Friedlaender, Chairman.
D-13 on Textile Materials. B. L. Whittier, Chairman.
D-22 on Methods of Atmospheric Sampling and Analysis. L. C. McCabe, Chairman.
D-23 on Cellulose and Cellulose Derivatives. F. A. Simmonds, Chairman.
E-12 on Appearance. M. Rea Paul, Chairman.

Monday, June 17 8:00 p.m. Fourth Session

Held simultaneously with the Fifth and Sixth Sessions

Session on Steel

The Effect of Phosphorus on the Susceptibility to Temper Embrittlement of Cast Cr-Mo-V Steel. J. Chaberek and R. S. Zeno, General Electric Co.

Test material at phosphorus levels of 0.008, 0.02, 0.05, and 0.08 nominal weight per cent was isothermally aged at 900 and 950 F for 1000 hr. V-notch Charpy impact transition temperatures (used as a basis for determining susceptibility to temper embrittlement) were obtained for each phosphorus level before and after the embrittling heat treatment. Room-temperature tension properties were determined for all material isothermally aged. It was found that isothermally aged material at phosphorus levels higher than 0.02 per cent were susceptible to temper embrittlement.

The Static Properties of Several High-Strength Steels. E. P. Klier, B. B. Muvdi, and G. Sachs, Syracuse University, Research Inst.

The tension and notch-tension properties of steels heat-treated to tensile strengths in the 200,000 to 300,000 psi range have been determined. Factors which have in some measure been subjected to systematic examination are: steel hardenability, as-processed section size, as-tested section size, tempering temperature, stress concentration, directionality, eccentricity, and loading time.

Behavior of Open Hearth and Bessemer Seamless Steel Pipe. A. B. Wilder and W. P. Benter, National Tube Division, United States Steel Corp.

Carbon steels made by the basic open hearth and acid bessemer process were rolled into seamless pipe and tested. The aging characteristics after cold working and also after quenching were evaluated. Fatigue properties, impact properties, and welding characteristics were investigated. Grade B bessemer seamless pipe had mechanical properties and welding characteristics similar to the grade B open hearth seamless pipe. The toughness properties of the killed bessemer steels were similar to the open hearth steels and were superior to the capped steels. The superior properties of deoxidized acid bessemer steel are shown.

Monday, June 17 8:00 p.m. Fifth Session

Held simultaneously with the Fourth and Sixth Sessions

Session on Fatigue

Cyclic Strain Fatigue Studies on AISI Type 347 Stainless Steel. E. E. Baldwin, G. Sokol, and L. G. Coffin, Jr., General Electric Co.

Constant temperature cyclic strains ranged from 0.0035 in. per in. to 0.02 in. per in. Parameters of the testing program include temperature, grain size, anisotropy, and sequence of loading. Results are given in terms of the stress range, total strain range, and plastic strain range. Good agreement is found when applying the previously determined relationship $N^{1/2}\Delta\epsilon p = c$, both for the exponent $1/2$ and the constant c. When considering the above relationship, neither grain size nor anisotropy appear to have a significant effect. On the other hand, the temperature parameter has a pronounced effect on the constant c which is not indicated by the fracture ductility. Damage produced by sequential loading was determined by a modification of Miner's relationship for comparison with tests conducted by single cyclic strains. Life in sequential loads varied from 72 to 163 per cent of the life found in the simple tests.

The Fatigue Properties of Decarburized Steel. G. T. Horne and H. A. Lipsitt, Carnegie Institute of Technology.

Fatigue tests in a completely reversed axial tension-compression have been made on a mild steel (in the hot rolled condition) and on specimens of this steel after decarburization. Further, rotating beam (R. R. Moore) fatigue tests have been made on the decarburized material in an effort better to define the fatigue limit behavior of this very low carbon (−0.003 per cent) material. The material used and its preparation for testing in the as received (hot rolled) and as decarburized conditions is detailed and the results of these tests discussed. The data on the materials (as received and as decarburized) are discussed in the light of a strain-aging explanation to account for their difference.

Cracking of Notch Fatigue Specimens. M. S. Hunter and W. G. Fricke, Alcoa Research Laboratories, Aluminum Company of America.

The initiation and surface propagation of fatigue cracks within a series of rotating-beam fatigue specimens containing notches ranging in severity from very mild to extremely severe has been observed at high magnifications. The theoretical stress at the root of the notch largely controls the number of cycles at which a crack is formed

and the rate of propagation of the crack along the notch, at least when the crack is small. Provided the theoretical stress at the notch root exceeds a critical value roughly identifiable with the endurance limit of smooth specimens, cracks will form even though the test stress is insufficient to cause complete failure. However, cracks formed at stresses below the notch endurance limit do not individually grow to large size.

Effect of Grinding Conditions and Resultant Residual Stresses on the Fatigue Strength of Hardened Steel. L. P. Tarasov, Norton Co., W. S. Hyler, Battelle Memorial Inst., and H. R. Letner, General Electric Co.

Results are presented of investigation of effects of longitudinal grinding conditions (wheel hardness, grinding fluid, unit down-feed) on fatigue strength of flat test bars of hardened steel similar to AISI 52100. Residual stress studies were made on specimens from each group for correlation with fatigue results. Results showed that although moderately high subsurface tensile stresses may arise under commercial grinding practices, these have little detrimental effect on fatigue limit. Certain grinding practices promote high surface compressive stresses. These, together with mechanical working during grinding, appreciably raise fatigue limit. Correlation exists between fatigue limit and residual tensile stress (surface or subsurface), modified by mechanical working. Scatter in fatigue results appears a function of variability in residual stress patterns (for identically ground bars) and inclusions in steel.

Fretting Fatigue Strength of Titanium Alloy RC 130 B. H. W. Liu, H. T. Corten, and G. M. Sinclair, University of Illinois.

An investigation was made to determine the influence of a number of variables including different gripping materials, hardness of the gripping materials, gripping pressure, surface preparation of specimens, dry lubricants, metallic coatings, and special screen-gripping shims. Analysis of experimental results suggests that the primary mechanism responsible for fretting fatigue damage is the repeated frictional shear stress on the asperities or surface "high spots" which are in contact. Based on prevention of fatigue-crack initiation by this mechanism, a mathematical expression is proposed that relates the fretting fatigue strength to the fatigue limit, hardness of gripping material, and coefficient of friction.

Monday, June 17 8:00 p.m. Sixth Session

Held simultaneously with the Fourth and Fifth Sessions

Session on Concrete

The Freeze-Thaw Resistance of Concrete as Affected by the Method of Test. H. L. Flack, U. S. Bureau of Reclamation.

Reliable test information is needed to predict the ability of concrete in field structures to resist the destructive effects of freezing and thawing action. Since many laboratory freezing and thawing test procedures are being used by different investigators, the authors report their findings on the effects of various factors such as preliminary curing, degree of saturation, specimen size, different freezing and thawing methods, and temperatures and duration of cycle. Several combinations of freezing and thawing periods including all four tentative ASTM methods were used to test various types of concrete with and without entrained air. In addition, the time-temperature relationships established for different locations in an 18-in. cylindrical specimen simulating structural concrete are shown for various patterns of freezing and thawing.

Instrumentation and Methods for Pairwise Impulse Testing of Reinforced Concrete Beams. F. T. Mavis, Carnegie Institute of Technology, and M. J. Greaves, Arthur G. McKee Co.

Reinforced concrete beams that were alike in all respects except grade of reinforcement were tested in pairs by a spring-loaded machine which released a single impulse between the two beams. The performance of the beams during a test (usually less than 50 milliseconds) was recorded photographically by a high-speed motion picture camera. Oscilloscope records of load and reaction were superimposed as continuous traces on motion picture photographs taken at 1 millisecond intervals. The apparatus, method of loading beams pairwise, and details of recording data are described along with summaries of typical data. The instrumentation and methods can readily be adapted to other research where transient data must be assembled in a few milliseconds for visual study and detailed analysis later.

Performance Tests of Concrete Truck Mixers. Albert G. Timms, Worthington Corp.

Performance tests of concrete truck mixers of inclined-axis type were made under field conditions. Split and ribbon loading and combinations of these were used and water was added either at plant or at job site. Samples were tested for slump, unit weight, air content, and strength; wash tests were made to determine uniformity of proportions and grading changes of the aggregates. Uniform pavement-type concrete with slumps below 2 in. was made and discharged rapidly. For the majority of loading conditions, satisfactory uniformity was obtained with the minimum revolutions of the drum recommended by ASTM Specification 94. The tests indicated the importance of having water in the drum for both ribbon and split loading, especially in split loads and where overloads were employed.

Designing Progressive Specifications for Quality Control of Concrete. E. A. Abdun-Nur, consulting engineer, and L. H. Tuthill, U. S. Bureau of Reclamation.

With emphasis on speed of construction, quality control is assuming increasing importance. To make control effective, it is necessary to create specifications that are keyed to the quality-control provisions desired. Such a step requires that specifications be designed individually for individual job conditions and requirements, and the much abused specification "copy" job becomes ineffective and obsolete. Designing such specifications is like designing a structure, and the use of "design criteria" for the development of realistic specification provisions is advanced. These include the use of "self-functioning" features, automation, contractor motivations, uniformity requirements, investigation of local conditions and practices, use of statistical methods, use of labor reducing features, elimination of expressions such as "as determined by the engineer" which cannot be evaluated realistically by the bidder, and, in general, deciding what is needed and requiring it clearly.

Cement-Aggregate Reaction in Concrete of a Canadian Bridge. E. G. Swenson, National Research Council of Canada.

This investigation is believed to be the first recorded instance in Canada of cement-aggregate reaction in concrete. Data are given on physical and chemical tests and petrographic evaluation of both the affected concrete and the aggregates from sources originally used. Two deck sections are involved, each built by different contractors using materials from different sources. In one section abnormal expansion and deterioration was shown to be the result of alkali-aggregate reaction due primarily to a phyllite component in the aggregate. In the second section excessive expansion was traced to the sand which was found to be reactive to the Conrow test.

(Continued in Sixteenth Session)

Tuesday, June 18 9:30 a.m. Seventh Session

Held simultaneously with the Eighth Session

Symposium on Determination of Gases in Metals

As the second in an annual series of symposia sponsored by Committee E-3 on timely subjects of interest and importance to ASTM members concerned with the analysis of material, the 1957 symposium is designed to review the present status of the determination of gaseous elements, particularly oxygen, in metals. Vacuum fusion analysis has been used for many years for gaseous elements in steel and alloys, but the apparatus was complex and fragile; and the analysis so time-consuming that it was seldom made except for the guidance of research work. With the advent of reactive metals such as titanium and more stringent specifications for other metals, for example, electronic grade nickel, interest in this determination has increased greatly.

In the planned symposium the conventional vacuum fusion apparatus and some modifications of it will be reviewed first and then some newer techniques and apparatus for these determinations will be described.

Two Apparati for the Determination of Gases in Metals. D. L. Guernsey and R. H. Franklin, Massachusetts Institute of Technology.

A versatile vacuum fusion apparatus is described and the use of metal bath techniques. Some of the problems involved are considered. An apparatus for the rapid determination of hydrogen is also described and discussed. Hot extraction and tin fusion of the samples are optional within the same system.

Application of Vacuum Fusion to Gas-Metal Studies. W. G. Guldner and A. L. Beach, Bell Telephone Laboratories.

The importance of vacuum fusion is shown by projecting a study of nickel from ingot to the finished product. Data show the effect of heat treatment, cleaning, and rolling on the gas content, oxygen, hydrogen, and nitrogen. The extension of this analytical method to other metals such as germanium, silicon, tantalum, and molybdenum involves a careful study to determine the most suitable bath for fusion. The inherent problems in working with fusion baths such as iron, iron-tin, nickel, and platinum-iron will be presented along with supporting data.

Oxygen Determinations Using a Platinum Bath and Capillary Trap. W. G. Smiley, Los Alamos Scientific Laboratory, University of California.

Samples are fused with platinum in a graphite crucible. A stream of argon at atmospheric pressure carries the carbon monoxide formed through a reagent that oxidizes it to carbon dioxide, which is condensed and measured in a capillary trap. The apparatus is simple and rugged, and most determinations require only 12 min. Platinum is preferred as a flux because of its very low vapor pressure and the limited solubility of carbon in the molten metal. The method is applicable to most metals which can be analyzed by vacuum fusion, and the precision and accuracy are comparable.

Bromination-Carbon Reduction Method for the Determination of Oxygen in Metals. Maurice Codell and George Norwitz, Pitman-Dunn Lab., Frankford Arsenal.

The principles of the bromination-carbon reduction method for the determination of oxygen in metals and an improved and simplified apparatus are discussed. The carbon dioxide produced can be determined gravimetrically or conductometrically. The gravimetric method is recommended for the determination of oxygen greater than 0.05 per cent the conductometric method for the determination of less than 0.02 per cent oxygen. The optimum temperature for the bromination reaction is about 925 C. At temperatures much less or greater than this reaction is slower. The use of purified bromine free from organic material is recommended. Argon is preferable to helium as a carrier gas. The bromination-carbon reduction method has been applied to the determination of oxygen in titanium, zirconium, chromium, vanadium, and steels. It is not applicable to steels containing oxide inclusions.

Emission Spectrometric Determination of Oxygen in Metals. V. A. Fassel, W. A. Gordon, and R. W. Tabeling, Institute for Atomic Research and Department of Chemistry, Iowa State College.

The problems encountered in extending emission spectrometric methods to the determination of the oxygen content of metals will be surveyed and several techniques for surmounting some of these problems will be discussed. Methods for the determination of oxygen in steel, titanium, the rare earths, and other metals will be discussed in detail. These procedures are based on the liberation of the oxygen content of the metal into an argon atmosphere by the high temperatures attained in direct-current arc discharges. The intensity ratio of the line pair $\frac{O\ 7771.9}{A\ 7891.1}$ is related to the oxygen content of the metal sample. The results of preliminary studies on the emission spectrometric determination of hydrogen and nitrogen in metals will be summarized.

Tuesday, June 18 9:30 a.m. Eighth Session

Held simultaneously with the Seventh Session

Symposium on Large Fatigue Testing Machines and Their Results

A Unique Machine for Large Scale Fatigue Testing. H. V. Cordiano, New York Naval Shipyard.

This machine for evaluating structural elements and box-shaped specimens under repeated bending, operates on the principle of the dynamic vibration absorber. The alternating couple, developed in the main frame by two sets of eccentric disks rotating on parallel shafts in the same direction but 180 deg out of phase with each other, is balanced by the bending moment induced in the specimen when the system of specimen and attached mass is vibrating at its natural frequency. The bending moment induced in the specimen is uniform along the length, and may be increased from zero to a maximum in 50 steps through adjustment of the multiple eccentric disks. Fatigue data obtained on welded and riveted joints in ship alloy steel and medium steel plate are presented.

Torsional Fatigue Testing of Axle Shafts. Edwin J. Eckert, Caterpillar Tractor Co.

In the process of developing high strength axle shafts for large earthmoving machines, it was found necessary to design and build fatigue testing machines capable of testing shafts up to 4 in. in diameter. These machines were to be used to determine fatigue strengths of shafts in the low cycle range. Torsional loads up to 90,000 ft lb in one direction were desired at a rate of approximately two cycles per second. Variables tested to determine their effect on the fatigue of shafts in the low cycle range were: (1) hardness, (2) straightening, (3) surface defects, and (4) shot peening. A comparison was also made between the static strength and the fatigue strength.

(Continued in the Tenth Session)

Fatigue Testing of Airframe Structural Components. H. W. Foster, Lockheed Aircraft Corp.

The fatigue strength evaluation of airframe structural sections and components is discussed with particular reference to development of test specifications and requirements for testing equipment. Examples are presented of airframe component tests at Lockheed Aircraft Corp. and the test equipment is illustrated and discussed.

Tuesday, June 18 12:00 noon Ninth Session

Luncheon Session—President's Address, Introduction of New Officers 50-Year Members Recognition, Report of Board of Directors

President R. A. Schatzel will discuss, in part, ASTM cooperative relations. 50-Year Members include Herbert Abraham (President, The Ruberoid Co.), Henry C. Boynton (consulting metallurgist, formerly with J. A. Roebling's Sons Corp.), John Fairfield Thompson (chairman of the board, The International Nickel Co. of Canada, Ltd.), Morton Owen Withey (retired dean of engineering, University of Wisconsin), and three organizations, Reading Company, Rensselaer Polytechnic Institute, and The Youngstown Sheet and Tube Co. Dr. Thompson will respond for the 50-Year Members. A separate article in this BULLETIN lists the nominees for national officers, who will be introduced.

Tuesday, June 18 2:30 p.m. Tenth Session

Held simultaneously with the Eleventh Session

Symposium on Large Fatigue Testing Machines and Their Results (Continued)

Fatigue Performance of Marine Shafting Laboratory and Service Tests. T. W. Bunyan, Lloyd's Register of Shipping.

A large scale fatigue testing machine developed by the Research Department of Lloyd's Register of Shipping is described along with results of fatigue tests in reversed torsion using solid forged mild steel specimens up to 10-in. diameter for the purpose of investigating stress concentrations of fillet radii, size effect, and the mechanism of strain hardening and crack propagation. The paper also deals with service failures of shafting and refers to measured or calculated stresses for marine machinery. Reference is made to the permissible limits for torsional vibratory stresses allowed by the marine classification societies.

Fretting Corrosion of Large Shafts as Influenced by Surface Treatments. O. J. Horger and H. R. Neifert, The Timken Roller Bearing Co.

Rotating bending fatigue tests were made on 7 9/16 in. diameter normalized and tempered 0.50 per cent plain carbon steel shaft forgings having a press-fitted outer disk member. The disk seats of some assemblies were chrome plated, while others were treated by phosphate coating. The limited number of tests indicate appreciable improvement in fatigue resistance by chrome plating and little if any by phosphate coating. More tests are needed for quantitative evaluation. Tests on model tailshaft assemblies having a welded layer of good quality deposited on the 5¾ in. diameter propeller hub seat showed fatigue resistance of these tailshafts to be no different than nonwelded shafts of the same plain carbon steel to MIL-S-890, class B specification. Information is presented on the actual surface rolling of about 27 in. diameter marine propeller shafting.

Fatigue Tests of Large Alloy Steel Shafts. F. C. Eaton, Westinghouse Electric Corp.

Four 9-in. diameter unnotched alloy-steel shafts have been fatigued in rotating bending tests. The testing machine used is the rotating beam type that applies the load to the shaft through misalignment of the bearings. This arrangement results in a relatively inexpensive test set-up but does require fairly long specimens in order to obtain desired bending stress and maintain reasonable bearing loads. From the results of the four shafts broken it appears the endurance limit is approximately 36,000 psi. Small diameter fatigue specimens have been removed from an unstressed section of one of the shafts. Tests of these small specimens show an endurance limit of 55,000 psi. These results indicate a definite size effect.

A Quarter Century of Propulsion Shafting Design Practice and Operating Experience in the U. S. Navy. R. Michel, Bureau of Ships, Navy Dept.

Operating experiences indicate the principal sources of trouble to have been due to galvanic corrosion, vibration, and frettage corrosion. In order to decrease the former, shafts are being covered with synthetic rubber. In addition, improved methods of cathodic protection are being used, so that the percentage of replacements and repairs due to salt water corrosion has been greatly reduced since World War II. Improved techniques for measuring vibratory stresses have increased our knowledge of transient forces on shafts. Computation methods have been revised to change the design from an empirical to a more nearly analytical one. This change, together with the use of higher strength materials, has resulted in a large reduction in the weight of propulsion shafting.

Tuesday, June 18 2:30 p.m. Eleventh Session

Held simultaneously with the Tenth Session

Symposium on Spectrochemical Analysis for Trace Elements

The purpose of this symposium is to present in a condensed manner several of the diverse aspects of spectrographic trace analysis. Because of its speed and versatility this method has been applied to a variety of materials where the problems encountered, the techniques employed to solve them, and results obtained show wide variation. This variation probably can be traced to the influence which technique exerts in getting satisfactory results. The papers will discuss problems of trace analysis associated with a particular type of matrix such as metals, semiconductors, medical and biological materials, plants and soils, and geological materials.

Emission Spectrometric Determination of Oxygen in Metals. V. A. Fassel, W. A. Gordon and R. W. Tabeling, Institute for Atomic Research and Department of Chemistry, Iowa State College. (For abstract see same paper listed under Sym. on Determination of Gases in Metals.)

The Determination of Trace Elements in Metals. J. A. Norris, Oak Ridge National Laboratory.

The determination of trace (less than 100 ppm) quantities of various elements in metals such as iron and steel, copper, aluminum, and others will be surveyed. The methods will be divided in general into four categories: (1) direct determination, (2) chemical pretreatment, (3) carrier techniques, and (4) total separation with or without new matrix.

(Continued in Fourteenth Session)

Trace Analysis by Means of the Graphite Spark. James M. Morris and Francis X. Pink, Metal Hydrides Inc.

A method is described for the determination of trace impurities below the 1 ppm level. Although the method was developed for the analysis of semiconductor materials, it may be applied to a wide variety of samples. A concentrational step and chemical separation are employed prior to spectrographic analysis. An a-c spark is used between graphite electrodes, resulting in increased precision and accuracy. The samples, in solution form, are pipetted onto the surface of high purity graphite electrodes. The solutions are evaporated to dryness and sparked. Excitation conditions, standard preparation, and analytical data are given. Millimicrograms of impurities are determined with an average standard deviation σ of 2.7 at 5 $\times$ the sensitivity limit.

Tuesday, June 18 2:30 p.m.

Discussion on Electron Metallography

Sponsored by Committee E-4 on Metallography. L. D. Wyman, Chairman; Mary R. Norton, Secretary.

This open technical session will include a progress report by Titanium Task Group, reports on suggested standards for electron metallographic replication, and several papers on electron metallography by committee members.

Tuesday, June 18 4:30 p.m. Twelfth Session

Committee Report Session

A-1 on Steel. W. F. Collins, Chairman.
A-9 on Ferro-Alloys. S. W. Poole, Chairman.
B-7 on Light Metals and Alloys, Cast and Wrought. I. V. Williams, Chairman.
E-9 on Fatigue. R. E. Peterson, Chairman.
E-11 on Quality Control of Materials. H. F. Dodge, Chairman.
Report of Joint Committee on Effect of Temperature on the Properties of Metals. V. T. Malcolm, Chairman.
Report of Joint Committee on Leather. J. R. Kanagy, Chairman.

Tuesday, June 18 5:00 p.m. Thirteenth Session

Gillett Memorial Lecture

A Perspective of Molybdenum Base Alloys. Alvin J. Herzig, president, Climax Molybdenum Co. of Michigan

This Lecture, established in 1951, is jointly sponsored by ASTM with Battelle Memorial Institute. It commemorates Horace W. Gillett, one of America's leading technologists and metallurgists and the first Director of Battelle. The Lecture is delivered annually at a meeting of the Society, the first one having been given at the Fiftieth Anniversary Meeting, June, 1952. The Lecture will cover subjects pertaining to the development, testing, evaluation, and application of metals. [See abstract on p. 8.]

Tuesday, June 18 8:00 p.m. Fourteenth Session

Held simultaneously with the Fifteenth and Sixteenth Sessions

Symposium on Spectrochemical Analysis for Trace Elements (Continued)

Medical and Biological Materials. Bert Vallee, Harvard Medical School and Peter Bent Brigham Hospital.

Plants and Soils. W. G. Schrenk, Kansas State College.

Spectrographic methods may be developed in this field of study by following the general principles of sample preparation, buffers, internal standards, electrode preparation, and excitation conditions, developed by spectrographers in all fields. The general techniques used in applying spectroscopy to plant and soil samples will be reviewed.

Problems concerning spectrographic analysis of plants and soils will differ depending on the type of information desired. In certain cases special spectroscopic techniques may need to be developed.

To illustrate methods used and results that may be expected data obtained in several problems studied at the Kansas Agricultural Experiment Station will be presented.

Geological Materials. K. J. Murata, U. S. Geological Survey.

Because 99 per cent of the earth's crust consists of only ten elements, all with atomic numbers smaller than 27, most of the elements are trace constituents of the crust. Semiquantitative and quantitative spectrochemical methods are being used extensively in basic geochemical studies on the distribution of the elements in crustal rocks, in systematic exploration for hidden ore deposits, and in determination of byproduct elements in ores. Trace analysis of natural crystals are of interest with respect to structure-sensitive properties such as fluorescence. Trace elements in river and ocean waters constitute a challenging subject for research.

Tuesday, June 18 8:00 p.m. Fifteenth Session

Held simultaneously with the Fourteenth and Sixteenth Sessions

Session on Non Ferrous Metals

Ultrasonic Testing of Aluminum Alloys. W. L. Fink, Alcoa Research Labs., Aluminum Company of America.

The standardization of ultrasonic testing procedures and instruments for the inspection of aluminum alloy products is described with emphasis upon reproducibility and the correction of ultrasonic indications for metal distance and other disturbing factors. The author discusses the types of discontinuities most commonly encountered in aluminum alloys and the reflection of ultrasound by them. The latter half of the paper is devoted to the effect of discontinuities on properties with emphasis upon fatigue life. It is shown that acceptance standards should be based on a zoning principle that requires the most rigid standards for those extremely small critical regions in which there are high stress concentrations and in which the plane of the discontinuity lies perpendicular to the direction of loading.

Electrical Resistivity and Thermoelectric Potential of Rhenium Metal. G. B. Gaines and C. T. Sims, Battelle Memorial Inst.

The electrical resistivity of high-purity rhenium metal was measured from room temperature to 2600 K. The measured resistivity values as a function of temperature can be represented to a high degree of accuracy by a cubic equation. The electrical resistivity of Pt-1.0 Re and Pt-2.0 Re alloys were also measured. The thermoelectric potentials generated by Re-Mo, Re-W, and Re-Ta junctions were measured from 870 to 2490 C. Over this temperature range, the Re-W and Re-Mo junctions produce high thermoelectric potentials which vary reasonably linearly with temperature. They show considerable promise as thermocouples. The Re-Ta junction behaves in a peculiar manner. Junctions of Pt-1.0 Re and Pt-2.0 Re versus Pt were investigated up to 1300 C.

Factors Affecting the Strength and Hardness of Beryllium Copper Strip. J. T. Richards and E. M. Smith, Penn Precision Products, Inc.

Cold work, heat treatment, thickness, grain size affect the strength and hardness of beryllium copper strip. The influence of these factors on specification properties as well as hardness conversion and certain modifications of existing specifications based on statistic analysis are discussed.

Tuesday, June 18 8:00 p.m. Sixteenth Session

Held simultaneously with the Fourteenth and Fifteenth Sessions

Session on Concrete (Continued)

Insulating Concretes and Compressive Strength. Morton Sherman Zonolite Co.

With little experimental evidence to the contrary, testing laboratories have found it necessary to apply erroneously to insulating concretes many techniques and relationships proper for dense concretes. Some basic ideas in this paper are: (1) abnormal specimen height at casting can facilitate the formation of density gradients in the concrete specimen to be tested, (2) without abnormal specimen heights, the height-width ratio of a test specimen can vary from 0.5 to 2.0 without seriously affecting the reliability of the measured strength, (3) the effect of loading rate on the magnitude of strength measured does not appear to be as critical as a variation in the dry density of the concrete under test, and (4) improper curing can affect the reproducibility of measured compression strength.

Flexural Strength Testing of Concrete. Stanton Walker and D. L. Bloem, National Sand and Gravel Assn. and National Ready Mixed Concrete Assn.

The authors describe studies of the effects of variations in testing conditions on the measured flexural strength of concrete. Variables included moisture content and distribution, size of specimen, eccentricity of load, direction of loading in relation to position as molded, and effects of sawing specimens from hardened concrete. It was found that tests for modulus of rupture are highly sensitive to small variations in certain phases of the testing procedure but not to others. It seems probable that the necessary conditions for securing accurate and reproducible results can be attained only under most careful control. In most cases, testing facilities available in the field would be inadequate to permit use of flexural strength as an acceptance criterion for the concrete.

Measuring the Rate of Hardening of Concrete by Bond Pullout Pins. T. M. Kelly and D. E. Bryant, Master Builders Research Labs.

This method for measuring the rate of hardening of concrete consists, basically, of the determination of the rate of development of bond strength. For this purpose stainless steel pins are embedded vertically in a concrete specimen immediately after the concrete is mixed. Individual pins are subsequently pulled out at various time intervals and the load at which bond failure occurs in each case is measured. A rate of hardening curve is obtained by plotting bond strengths against time. Curves are shown for various concrete mixes.

Wear Tests on Concrete Using the German Standard Method of Test and Machine. James L. Sawyer, Lone Star Cement Corp.

In practice a floor surface must withstand large wheel pressures. It has long been realized that a test was needed to measure the resistance of concrete surfaces to wear. Work has been done in Germany and in this country to develop a test method yielding reproducible results. A German abrasion test machine duplicates a practical wear condition by rolling steel balls under pressure across the concrete surface. The test is sensitive and results are reproducible and easily obtained. Results indicate that adequate curing is essential and that some relationship exists between compressive strength and wear resistance.

Wednesday, June 19 9:30 a.m. Seventeenth Session

Session on High Temperature

Embrittlement Tendencies of Austenitic Superheater Materials at Elevated Temperatures. J. H. Hoke and F. Eberle, Babcock & Wilcox Co.

To determine more fully the effect of long-time elevated temperature exposure on the properties of standard and developmental austenitic superheater materials, nine wrought and nine weld alloys were exposed in the temperature range of 1200 to 1500 F for periods of time up to 20,000 hr. Changes reported in the properties were followed principally by room and elevated temperature notched bar impact tests as well as by tension and side bend tests.

All materials become embrittled to some extent by aging. This occurs most rapidly during the first 1000 hr or less of exposure after which the rate of change gradually decreases. Most wrought materials retained what is felt to be adequate impact resistance for superheater service, but several of the weld metals were seriously embrittled. After aging these materials have greater impact strength at operating than at room temperature.

Influence of Specimen Preparation and Eccentricity of Loading on the Notch Rupture Strength of a Cr-Mo-V Steel and the Austenitic Alloy A-286. M. H. Jones, J. L. Shannon, and W. F. Brown, Jr., NACA, Lewis Flight Propulsion Lab.

Specimens were notched either by tool cutting or by grinding both before and after complete heat treatment. For most tests the notch geometry conformed to that previously employed by the NACA, namely, a 60 deg sharp "V" notch removing 50 per cent of the cross-sectional area and having a root radius of 0.001 in. or less. In addition, a few tests were made using an 0.008 in. root radius. The influence of loading eccentricity was investigated for the Cr-Mo-V steel using sharply notched specimens. The range of eccentricity varied from approximately 0.0005 to 0.10 in. For both phases of the investigation, testing conditions were selected which yielded either very high or very low notch rupture strength ratios. Results indicate that tool cut notch specimens of A-286 heat treated before machining are considerably stronger than similar specimens provided with ground notches. For this alloy, specimens heat treated after notching are distinctly weaker than those heat treated before notching. In contrast, the notch strength of the Cr-Mo-V steel was essentially identical for all conditions of notch preparation investigated. Regarding the influence of eccentricity, very small eccentricities of loading reduce the notch strength of the Cr-Mo-V steel when tested under conditions yielding low concentric notch rupture strength ratios (low notch ductilities). On the other hand if the testing conditions result in high notch ductility, the influence of small eccentricities is negligible.

(Continued in Twentieth Session)

Constant Stress, Creep-Rupture Tests of a Killed Carbon Steel. Pryor N. Randall, Standard Oil (Indiana).

The unique features of the test equipment described are: means for maintaining constant stress throughout the test by a reduction of the lever ratio as the specimen stretches; provision for adjustment of axiality of load; continuous recording of elongation; and temperature control by a servo system which adjusts voltage to the furnace continuously. The paper presents stress-rupture data and also true strain rate versus time data for 40 pairs of specimens tested to rupture at five temperatures from 800 to 1200 F and for times ranging from 0.05 to 15,000 hr. Two minima in the creep rate were found in the longer tests at the three lower temperatures. Tests to find an explanation are described.

Microhardness Testing at High Temperatures. J. H. Westbrook, General Electric Co.

The author describes the construction, operation, and characteristics of a hot-hardness tester of modified Bergh design with a temperature range of 20 to 1500 C and a load range of 20 to 900 g. The problems encountered in this type of test, particularly with respect to hard, brittle materials, are discussed in some detail. Typical results are shown, and examples of the application of this test described.

Wednesday, June 19 11:15 a.m. Eighteenth Session

Committee Report Session

A Cooperative Investigation of the Method of Test for Compressive Strength of Bituminous Mixtures. C. E. Proudley and H. Fred Waller, Jr., North Carolina State Highway Commission.

North Carolina bituminous paving specifications include a stability requirement based on ASTM Method D 1074. Contractors, among others, have become seriously concerned financially over the wide variations in test values obtained by commercial laboratories and the State Highway Laboratory using the same procedure. In eight rounds of cooperative tests by seven laboratories the maximum deviations from the averages varied from a low of ±6 per cent to a high of ±20 per cent, the average being ±13 per cent. The author recommends that Method D 1074 be further revised to describe details of preparation of the test specimens and their manipulation throughout the test procedure more precisely with a minimum of option for the laboratory technician.

C-7 on Lime. J. A. Murray, Chairman.

C-9 on Concrete and Concrete Aggregates. W. H. Price, Chairman.

C-13 on Concrete Pipe. R. R. Litehiser, Chairman.

D-8 on Bituminous Waterproofing and Roofing Materials. H. R. Snoke, Chairman.

D-18 on Soils for Engineering Purposes. E. J. Kilcawley, Chairman.

E-5 on Fire Tests of Materials and Construction. W. J. Krefeld, Chairman.

E-6 on Methods of Testing Building Constructions. R. F. Legget, Chairman.

Wednesday, June 19 12:00 noon Nineteenth Session

Awards Luncheon—Awards of Merit, Dudley Medal Award, Templin, Tour, and Richart Awards, Max Hecht, Sanford E. Thompson, and C. A. Hogentogler Awards, 40-Year Members Recognition.

Wednesday, June 19 2:30 p.m. Twentieth Session

Session on High Temperature (Continued)

An Experimental Study of Compressive-Creep Behavior at Elevated Temperatures. R. L. Carlson and E. G. Bodine, Battelle Memorial Institute.

Strain-versus-time curves for specimens of the aluminum alloy 2024-T4 tested in uniform compression exhibited decreasing creep rates during the initial part of the tests, and increasing creep rates during the final stage. Since the cross-sectional area increases with time in compression, the results cannot be attributed to a "necking" of the specimens. Metallographic examination of the specimens did not reveal any evidence of "internal" cracking. A review of the aging characteristics of this alloy at these temperatures, however, suggests that the accelerated creep rate is associated with the loss in strength that occurs with aging. The effect of imperfection on the time-to-collapse of short columns with hinged ends is shown to be quite significant. The time to collapse increases markedly as the imperfection decreases.

Tensile and Creep Properties of Tungsten at Elevated Temperatures. J. W. Pugh, General Electric Co.

A detailed analysis of the creep and tension properties of commercial grade tungsten rod between room temperature and 2200 F shows it to be stronger than other refractory metals and to compare favorably with molybdenum and chromium when tested at the same fraction of its melting point. The ultimate tensile strength of recrystallized tungsten is found to vary between 79,600 psi at 200 F to 33,500 at 2000 F. Tensile strength for cold swaged and stress-relief annealed tungsten was 145,000 to 59,000 psi for the same temperature range.

Creep-rupture properties of tungsten at 1600, 1800, 2000, and 2200 F were found to be outstanding for a pure metal. It is generally superior to molybdenum and to the better austenitic superalloys in this range. For example, 1000 hr stress-rupture stresses at 1600, 1800 and 2000 F are 31,000, 22,000, and 15,500 respectively.

Dynamic Elastic Modulus Values at Elevated Temperatures for Nickel Base, Aluminum Base and Metal-Metal Oxide Alloys. Robert F. Wilde, General Motors Corp., and Nicholas J. Grant, Massachusetts Institute of Technology.

Elastic modulus was measured by a dynamic method for a series of alloys which included: nickel-base alloys, such as Inconel X 550, Inco 700, Waspalloy M-252, and three experimental vacuum-melted compositions based on the pure system nickel-chromium-titanium-aluminum, all tested in the temperature range 80 to 1600 F. Type 316 stainless steel was tested from 80 to 1600 F. Pure aluminum and a series of high-purity solid solution alloys containing zinc, or magnesium, or copper were tested from 80 to 800 F. In addition, a number of sintered, extruded metal-metal oxide alloys of copper containing increasing amounts of Cu_2O, of copper containing increasing amounts of SiO_2, of copper containing increasing amounts of Al_2O_3 were tested to determine the effects of fine oxide distribution on the elastic modulus as a function of increasing temperature.

Effect of Composition on the Creep Properties of Ductile Iron. R. D. Schelleng and J. T. Eash, The International Nickel Co., Inc.

Creep properties of several ferritic ductile irons at temperatures from 600 to 1000 F are presented and the effects of variations in phosphorus, copper, and molybdenum contents are shown. Data are given for: stress-rupture at 800 and 1000 F, tensile strength from room temperature to 1000 F; and creep and rupture on several austenitic ductile irons containing 20–35 nickel, 2–3 chromium and 0–1 molybdenum. A wide range of properties at elevated temperature is obtainable in ductile iron through alloy additions. The properties of the ferritic material are comparable to those of low-carbon steels and those of the nickel-austenitic materials are similar to the properties of some stainless steels.

Wednesday, June 19 4:00 p.m. Twenty-First Session

Committee Report Session

Held simultaneously with the Twenty-Second Session

B-1 on Wires for Electrical Conductors. D. Halloran, Chairman.

B-2 on Non-Ferrous Metals and Alloys. Bruce W. Gonser, Chairman.

B-3 on Corrosion of Non-Ferrous Metals. K. G. Compton, Chairman.

B-5 on Copper and Copper Alloys, Cast and Wrought. G. H. Harnden, Chairman.

B-6 on Die-Cast Metals and Alloys. W. Babington, Chairman.

B-8 on Electrodeposited Metallic Coatings. C. H. Sample, Chairman.

B-9 on Metal Powders and Metal Powder Products. J. L. Bonanno, Chairman.

Wednesday, June 19 4:00 p.m. Twenty-Second Session

Committee Report Session

Held simultaneously with the Twenty-First Session

D-1 on Paint, Varnish, Lacquer and Related Products. W. T. Pearce, Chairman.
D-11 on Rubber and Rubber-Like Materials. Simon Collier, Chairman.
D-14 on Adhesives. R. F. Blomquist, Chairman.
D-20 on Plastics. F. W. Reinhart, Chairman.
D-25 on Casein and Similar Protein Materials. H. W. Shader, Chairman.
E-3 on Chemical Analysis of Metals. Arba Thomas, Chairman.

Wednesday, June 19 4:30 p.m. Twenty-Third Session

Marburg Lecture

Your Most Important Raw Material—Water. Everett P. Partridge, director, Hall Laboratories

The purpose of the Edgar Marburg Lecture is to have described at the annual meetings of the Society, by leaders in their respective fields, outstanding developments in the promotion of knowledge of engineering materials. Established as a means of emphasizing the importance of the function of the Society of promoting knowledge of materials, the Lecture honors and perpetuates the memory of Edgar Marburg, first Secretary of the Society, who placed its work on a firm foundation and through his development of the technical programs brought wide recognition to the Society as a forum for the discussion of properties and tests of engineering materials. [See abstract on p. 8.]

Wednesday, June 19

Cocktail Party 6:30 p.m.

ANNUAL DINNER 7:30 p.m.

Entertainment

Thursday, June 20 9:30 a.m. Twenty-Fourth Session

Symposium on Radiation Effects on Materials

A highly successful symposium was presented on Radiation Effects on Materials, as part of the ASTM Second Pacific Area National Meeting, in September 1956. This symposium was jointly sponsored by the Subcommittee on Radiation Effects of the Atomic Industrial Forum's Committee on Reactor Materials and by ASTM's Committe E-10 on Radioactive Isotopes and Radiation Effects.

The importance of this subject and the interest shown at this symposium indicated the desirability of holding additional ones, perhaps on an annual basis. Consequently, the above groups agreed to sponsor this second symposium.

The symposium was organized with two or three papers dealing with the influence and use of radiation effect information on reactor design considerations, two on facilities and techniques involved in radiation studies, and perhaps six on radiation studies of specific materials of interest to reactor design. The resulting program should fulfill these objectives.

I. Consideration of Radiation Effects in Design

Systems Consideration Affecting Selection of Structural Materials for Nuclear Power Plant Components. Walter L. Fleischmann, Knolls Atomic Power Lab., General Electric Co.

Neutron irradiation and use of unusual coolants create conditions that are responsible for the great emphasis on material selection. Choice of material, however, depends on the reactor system and location of the material in relation to the reactor core.

In the core area, two basic types of interactions of neutrons with matter are: (*a*) the neutron with the atomic nucleus of the structural material, whereby the structural material, depending on its species, may become radioactive or may actually transmute; and (*b*) the neutron may cause disorder in the crystal lattice of the material and so cause changes in the properties of the material.

Material in contact with the coolant must be resistant to its attack; corrosion within the core area might cause long-lived isotopes to be removed and carried throughout the entire system.

Because of the premium on reliability, great emphasis is placed on nondestructive testing to assure soundness of materials and welds. Specific alloys which might be mentioned will be kept to a minimum to allow a more complete development of the effect of the nuclear system on the choice of materials.

Problems in Standardization of Techniques in Irradiation Effect Studies. M. J. Feldman and R. H. Fillnow, Westinghouse Atomic Power Division.

The authors discuss the techniques used in the design and analysis of experiments investigating the dimensional stability of reactor fuels, both the pre-post and in-pile type of experiments. The presentation also includes some of the major problems which are confronted in designing for the independent control of burnup, burnup rate, and temperature. Data on the nuclear limitations that are encountered in the reactor are presented. The experiments are compared with respect to ease of preparation, adaptability to the investigation, and ease of post-irradiation handling.

(Continued in the Twenty-Sixth Session)

II. Radiation Facilities and Techniques

Application of the Battelle Research Reactor to Radiation-Effects Studies. J. W. Chastain, Jr., Battelle Memorial Institute.

Radiation effects have been of interest to the scientists at Battelle since 1942 but previously all radiation exposures had to be conducted elsewhere. The Battelle Research Reactor has been completed and has passed through a series of "low-power" experiments and tests. The reactor is now operating at 1000 kw of heat power output to provide radiations for a large variety of experiments. In discussing the uses of the reactor, a brief summary of reactor types is given along with some of the advantages and disadvantages of each. Following a description of the Battelle Reactor the main fields of radiation interest of industry and of the Government are described. Methods of irradiating experiments and specific uses of the Battelle Reactor in the fields of radiation effects are delineated in this paper.

A Technique for Measurement of the Electrical Resistivity of Radioactive Metals. C. L. Boyd, General Electric Co., Hanford Laboratories.

A technique has been developed to obtain electrical resistivity data on irradiated metals over a temperature range of 20 to 100 C. Measurements are made by the potential drop method with the radioactive test specimen enclosed in a shielded enclosure or hot cell. The accuracy of measurements and a method of reducing the contact resistance of the oxide film on uranium specimens are presented.

Thursday, June 20 11:30 a.m. Twenty-Fifth Session

Committee Report Session

C-3 on Chemical-Resistant Mortars. Beaumont Thomas, Chairman.
C-8 on Refractories. J. J. Hazel, Chairman.
C-12 on Mortars for Unit Masonry. R. E. Copeland, Chairman.

C-14 on Glass and Glass Products. L. G. Ghering, Chairman.

C-16 on Thermal Insulating Materials. W. L. Gantz, Chairman.

C-21 on Ceramic Whiteware and Related Products. M. D. Burdick, Chairman.

C-22 on Porcelain Enamel. W. N. Harrison, Chairman.

Thursday, June 20 2:00 p.m. Twenty-Sixth Session

Symposium of Radiation Effects on Materials (Continued)

III. Radiation Effect Studies of Materials

Effect of Radiation on a Nuclear Fuel as a Function of Heat Treatment and Fuel Burnup. D. O. Leeser, Atomic Power Development Associates, and G. D. Calkins, Battelle Memorial Institute.

Engineering Effects of Radiation on Nuclear Fuels. B. Lustman, Westinghouse Atomic Power Division.

The effects of radiation on fissile solid fuels will be reviewed with respect to the limitations such effects impose on design and operation of fuel elements for power reactors. The following topics will be discussed: (1) dimensional stability, (2) effects of radiation on crystal structure and metallographic structure of various fuels, (3) stability of fuel and cladding materials in corroding environments under irradiation, (4) changes in mechanical properties, (5) accommodation and release of fission products, and (6) effects of heat production during fission on fuel element design.

A Survey of the Radiation Stability of Hydrocarbon Fuels. J. B. Carroll, R. O. Bolt, and J. A. Bert, California Research Corp.

The objective of this work was to determine the relative radiation stabilities of various types of hydrocarbon fuels. Included in the program were a gasoline stock, kerosine, stove oil, and typical JP-3, JP-4, and JP-5 jet fuels. Small samples of these materials were exposed to gamma radiation for dosages from 5×10^8 r to 50×10^8 r.

Results of postirradiation tests were compared with those from the original fuels. Data include ASTM distillations, Reid vapor pressures, aromatic and olefinic contents, carbon-hydrogen ratios, and viscosities. Gas evolution as a result of irradiation was also measured. The results obtained are intercompared for the various types of fuels.

Selection of Organic Materials as Reactor Coolant-Moderators. E. L. Colichman and H. R. J. Gercke, Atomics International, Division of American Aviation, Inc.

Previous work has demonstrated that some aromatic hydrocarbons are sufficiently stable to be used as nuclear reactor coolant-moderators. The materials being most seriously considered at the present time are diphenyl, terphenyls, and isopropyldiphenyls. Work has shown that radiation damage under reactor operating conditions results in only minor changes in properties of the coolant. Fouling of heat transfer surfaces has not been observed. Further study is needed on the nature and solubility of the decomposition products as well as gas solubility in the coolant and resultant effects. When comparing coolants, the following properties need to be evaluated: melting point, vapor-pressure, corrosivity, toxicity, radiation and pyrolytic stability, availability, and cost. A comparison of these properties is made for the more promising organic coolants with a discussion of the importance of these properties during reactor operation.

Effects of Radiation on Electronic Components. I. Semiconductor Junction Devices. G. J. Rotariu Cook Electric Co.

Semiconductor junction diodes exposed to nuclear radiation show little difference in damage in samples exposed to the full spectrum of a nuclear reactor and samples shielded with cadmium to eliminate thermal neutrons. Gamma radiation does not appear to cause the same kind of damage in the case of silicon devices as does radiation from the nuclear reactor but does affect germanium devices in the same manner. Other differences in behavior between silicon and germanium components are pointed out and possible mechanisms of damage discussed briefly.

Thursday, June 20 4:30 p.m. Twenty-Seventh Session

Committee Report Session

A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. Jerome Strauss, Chairman.

E-2 on Emission Spectroscopy. D. L. Fry, Chairman.
E-7 on Nondestructive Testing. J. H. Bly, Chairman.

E-13 on Absorption Spectroscopy. E. G. Rosenbaum, Chairman.

Thursday, June 20 4:30 p.m. Twenty-Eighth Session

Committee Report Session

D-5 on Coal and Coke. O. W. Rees, Chairman.

D-7 on Wood. L. J. Markwardt, Chairman.

D-12 on Soaps and Other Detergents. J. C. Harris, Chairman.
D-17 on Naval Stores. V. E. Grotlisch, Chairman.

D-21 on Wax Polishes and Related Material. W. W. Walton, Chairman.
D-24 on Carbon Black. S. R. Doner, Chairman.

Thursday, June 20 8:00 p.m. Twenty-Ninth Session

Symposium on Determination of Dissolved Oxygen in Water

The importance of dissolved oxygen in water used for biological and industrial processes does not diminish. Not only is it necessary to know the exact concentration at intervals, but in many processes unremitting vigilance must be maintained against momentary or periodic variations in this concentration.

This symposium presents the best current information on methods and apparatus for determination of dissolved oxygen in water, both by manual spot-check or calibration and instrumental continuous indication and record. The several papers discuss the principle, advantages, and disadvantages of their respective procedures and apparatus so that readers can select those most appropriate for their specific needs.

A Study of the Accuracy of Methods of Testing for Dissolved Oxygen in High Purity Water. K. G. Stoffer, Arabian American Oil Co.

This study was conducted to supplement an earlier one which evaluated the precision of the various tests. The basis of the present study was the quantitative addition of air-saturated water to high purity steam condensate with a nominally "zero" oxygen content. The methods included present ASTM referee and nonreferee procedures as well as the Schwartz-Gurney procedure along with potentiometric, dead-stop, and starch end-point titrations. Generally speaking, the statistical evaluation of the study confirmed the assumed greater accuracy of the referee methods compared to the other procedures; however, because of the extreme difficulty involved in obtaining water of known dissolved oxygen content, the absolute accuracy of the methods could not be evaluated clearly.

Polarographic Measurement of Dissolved Oxygen. W. W. Eckenfelder, Jr. and Brother Conrad Burris, Manhattan College.

Polarographic techniques have been found to be generally applicable for the determination of dissolved oxygen. The operating voltage for any system is selected from a current-voltage curve. For most systems commonly encountered 0.6 v can be used. At the operating voltage the current is directly proportional to the oxygen content. Residual current is determined following a nitrogen purge of the solution. Calibration is accomplished by preparing a curve of current versus dissolved oxygen using a modified Winkler technique as a standard. The calibration can be checked on air-saturated solution whose dissolved oxygen content is known from handbook solubility. The selection of the Winkler modification for standardization will depend on the chemical nature of the solution. Modified sampling and analytical techniques are described for dissolved oxygen and oxygen utilization measurement in the presence of biological sludges. Polarographic method is compared with chemical methods for several substances.

The Beckman Oxygen Analyzer. Thomas Finnegan and Ross C. Tucker, Niagara Mohawk Power Co.

The principle of the Beckman Analyzer for the determination of dissolved oxygen in water, the manner in which it has been operated, and the method of calibration are discussed. Examples are related of information regarding oxygen conditions which the instrument revealed and which would not have been detected readily by manual analysis.

Some criticisms of the model studied and suggestions for its improvement are made.

Evaluation of Hartmann and Braun Dissolved Oxygen Recorder. A. J. Ristaino and A. A. Dominick, U. S. Naval Engineering Experiment Station.

The Hartmann and Braun dissolved oxygen meter measures and records the electric current generated by the action of dissolved oxygen on a voltaic cell. The calibration of this current in terms of oxygen concentration with the ASTM referee chemical test is described. Methods and results of tests are given on the effects of temperature, pH, conductivity, and instrument reaction to surges of dissolved oxygen. Operational problems met during these tests are listed.

Determination of Dissolved Oxygen by Means of a Cambridge Analyzer. H. A. Grabowski, Combustion Engineering, Inc.

The recording oxygen analyzer has provided industry with a monitoring device in the detection and prevention of air leakage into the pre-boiler system. The author discusses the utility of the Cambridge unit together with the advantages and disadvantages observed in practice. The accuracy of measurement is high and the maintenance problem is low. These factors make this technique well suited for a high pressure steam generating system.

Friday, June 21 10:30 a.m. Thirtieth Session

Session on Masonry

Measuring Shrinkage of Concrete Block. E. L. Saxer and H. T. Toennies, National Concrete Masonry Assn.

Concrete masonry units, made with five different aggregates and cured by low-pressure steam or by autoclaving, were tested for drying shrinkage by three different methods. Auxiliary tests were made on prisms cut from companion block. Physical properties of the block and the aggregate were determined. The data indicate that the modified British test on whole block units could be substituted as an accelerated method of measuring shrinkage as it occurs during normal atmospheric drying. Measurements by the Modified British Method required approximately two weeks for completion. Measurements by the accelerated rapid test were substantially greater than those occurring with normal drying. No single correlation, applicable to all block, could be established between rapid test measurements and normal drying shrinkage, but a fair correlation was noted for block manufactured by a given curing technique. Measurements on cut prism sections were inconsistent and showed poor correlation with results obtained on whole block.

Recent Disintegration of Mortar in Brick Walls. C. C. Connor and W. E. Okerson, New Jersey Bell Telephone Co.

Sixty-four brick buildings were studied to determine the causes of a new type of mortar disintegration which had caused widespread damage since 1944. Fifty-one buildings had some disintegration; 13 had none. Apparently the disintegration was caused by efflorescence containing sodium and potassium sulphates. Mortars containing cement with over 0.6 per cent of sodium and potassium oxides consistently showed disintegration; but where the cement had a lower alkali content, disintegration either did not occur, or, in general, was much reduced. Brick with heavy sanding, or low suction, tended to increase the disintegration; rough surfaced brick reduced it. Workmanship probably affected the disintegration, but was not a controlling factor. Sand, lime, and temperature during bricklaying exerted no evident influence. Disintegration of the mortar increased with time.

Fallacies in the Current Percent of Total Absorption Method for Determining and Limiting the Moisture Content of Concrete Block. Carl A. Menzel, Portland Cement Assn.

The author shows why this longstanding test for moisture content in ASTM method C 140 is inadequate since it fails to give a significant and realistic indication of the moisture condition of concrete block such as is needed to reduce drying shrinkage, and cracking in concrete masonry walls. This method of test should be replaced as soon as possible by the sound scientific Relative Humidity Method described in a paper presented at the ASTM Annual Meeting in June 1955 and on page 1085, Vol. 55 of ASTM *Proceedings*.

The various fallacies of the current per cent of total absorption method are not generally known. Attempts are sometimes made to correlate the results between the two methods but this is impossible because of fundamental differences.

Friday, June 21 12:30 p.m. Thirty-First Session

Committee Report Session

A-3 on Cast Iron. D. E. Krause, Chairman.
A-5 on Corrosion of Iron and Steel. Marc Darrin, Chairman.
A-6 on Magnetic Properties. A. C. Beiler, Chairman.
B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts. E. I. Shobert, II, Chairman.
C-1 on Cement. R. R. Litehiser, Chairman.
C-11 on Gypsum. G. W. Josephson, Chairman.
Advisory Committee on Corrosion. Jerome Strauss, Chairman.

Friday, June 21 12:30 p.m. Thirty-Second Session

Committee Report Session

D-2 on Petroleum Products and Lubricants. Harold M. Smith, Chairman.
D-3 on Gaseous Fuels. ————, Chairman.
D-4 on Road and Paving Materials, K. B. Woods, Chairman.
D-6 on Paper and Paper Products. R. H. Carter, Chairman.
D-9 on Electrical Insulating Materials. H. K. Graves, Chairman.
D-15 on Engine Antifreezes. J. M. Clark, Chairman.
D-16 on Industrial Aromatic Hydrocarbons and Related Materials. D. F. Gould, Chairman.
D-19 on Industrial Water. Max Hecht, Chairman.
F-1 on Materials for Electron Tubes and Semiconductor Devices. S. A. Standing, Chairman.

Actions on ASTM Standards

The Administrative Committee on Standards is empowered to pass upon proposed new tentatives, and revisions of existing tentatives and standards offered between annual meetings of the Society. On the dates indicated below the Standards Committee took the following actions:

Thermal Insulating Materials

Tentative Specifications for Mineral Wool Block or Board Insulation for Elevated Temperatures (C 392 - 57 T) (Approved Jan. 31, 1957).

New Tentative.—This type of insulation has been in general commercial use for a number of years and is produced by several manufacturers. These specifications developed by Committee C-16 cover the composition, physical properties, and dimensions of the material for flat or nearly flat surfaces at temperatures up to 1800 F. For specific applications, actual temperature limits shall be agreed upon by supplier and purchaser.

Tentative Method of Sampling Preformed Thermal Insulation (C 390 - 57 T) (Approved March 6, 1957)

New Tentative.—Test procedures written by Committee C-16 consistently refer to some method of sampling. The use of a standard method will simplify such references. Quality control records maintained by a producer will usually suffice, and if it is mutually agreed between producer and consumer to accept lots on the basis of quality control records, no further sampling is required. This approach, designated Plan A, can be supplemented by a minimum amount of testing on not more than three random samples, Plan B. If neither of these plans can be agreed upon, a regular sampling procedure, known as Plan C, and outlined in this tentative, shall govern the acceptance of the material. The product specifications will cover, among other things, the character of the material, its physical properties, dimensional tolerances allowable, individual test limits, and other physical characteristics of the material offered for acceptance.

Definitions of Terms Relating to Thermal Insulating Materials (C 168 - 51) (Approved Jan. 31, 1957)

Tentative Revision.—This tentative revision consists of the addition of a definition for finishing cement which is regularly used with thermal insulation to improve its final appearance and protect the insulation.

Electrical Insulating Materials

Tentative Specifications for Silicone Varnished Glass Cloth and Tape (D 1459 - 57 T) (Approved Jan. 31, 1957)

New Tentative.—These materials, used at higher temperatures than most organic coated materials widely used in the electrical industry, are important commercial insulating materials for which uniform industry standards are needed. These Committee D-9 specifications cover material in the form of sheets, rolls, and tapes in two types for two uses: type A, where maximum electrical properties are required and type B, for maximum physical properties.

Tentative Methods of Testing Fully Cured Silicone Rubber Coated Glass Fabric and Tapes Used for Electrical Insulation (D 1458 - 57 T) (Approved Jan. 31, 1957)

New Tentative.—These methods cover sampling, conditioning, thickness, breaking strength, breaking strength after creasing, dielectric breakdown, dissipation factor and dielectric constant, volume resistance, weight, and threads per inch.

Tentative Methods of Test for Electrical Resistance of Insulating Materials (D 257 - 54 T) (Approved Jan. 31, 1957)

Revision.—This widely used method, a basic one in insulating materials, has been thoroughly revised to clarify and improve the procedure. An innovation is the use of the term "picofarad" which is synonymous with the familiar "micromicrofarad."

Rubber

Tentative Method for Strain Testing of Vulcanized Rubber (D 1457 - 57 T) (Approved Jan. 31, 1957)

New Tentative.—This method, used in industry for several years, describes a procedure for determining the strain of soft vulcanized rubber compounds under a specified stress. The strain is measured after the load has been suspended from the specimen for a specified period of time.

Tentative Method of Test for Change in Length of an Elastomeric Vulcanizate Resulting from Immersion in a Liquid (D 1460-57 T) (Approved March 6, 1957)

New Tentative.—This method was developed by Committee D-11 to replace the former Method B of Tentative Methods of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids (D 471 - 55 T). It is designed to give limited information regarding the effect of immersion by observing the change in length of the specimen through the transparent wall of the container. Although it may be employed with any liquid, it is especially applicable to liquids that are so volatile that they must be maintained under pressure during the period of immersion.

Tentative Methods of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids (D 471 - 55 T) (Approved March 6, 1957)

Revision.—Method B is eliminated and replaced by the new and separate method D 1460. (See immediately above).

Tentative Specifications for Elastomer Compounds for Automotive Applications (D 735 - 55 T) (Approved March 6, 1957)

Revision.—The SAE-ASTM Technical Committee on Automotive Rubber, in its test work, found that when compounds were made from silicone gum, certain properties in the tables could not be met consistently. On the basis of round-robin tests the committee recommended changing in Table V grade TA-706 elongation requirements from 150 to 125 per cent and volume change from 0 to 20 per cent to 0 to 15 per cent.

Tentative Methods of Dynamic Testing for Ply Separation and Cracking of Rubber Products (D 430 - 51 T) (Approved Jan. 31, 1957)

Revision.—These revisions were recommended to bring the methods more in line with current practice.

Tentative Methods of Testing Compressed Asbestos Sheet Packing (D 733 - 53 T) (Approved Jan. 31, 1957)

Revision.—The purpose of this revision is to eliminate some internal inconsistencies and also to make the method

more suitable for cross-reference required by the Specifications for Nonmetallic Gasket Materials for General Automotive and Aeronautical Purposes (D 1170).

Tentative Methods of Testing Rubber-Coated Fabrics (D 751 - 52 T) (Approved Jan. 31, 1957)

Revision.—As a result of experience in the use of these methods, the sections dealing with Weight, Hydrostatic Resistance, and Testing Machine have been clarified.

Tentative Method of Test for Resistance of Vulcanized Rubber or Synthetic Elastomers to Crack Growth (D 813 - 52 T) (Approved Jan. 31, 1957)

Revision.—This method has been revised to bring it in line with current practice.

Tentative Specifications and Methods of Test for Concentrated, Ammonia Preserved, Creamed and Centrifuged Natural Rubber Latex (D 1076 - 54 T) (Approved Jan. 31, 1957)

Revision.—The revision consists of the addition of methods for the determination of volatile fatty acids and KOH number, addition of tables for low ammonia latex with other preservatives, and a revision of scope.

Standard Method of Test for Weather Resistance Exposure of Automotive Rubber Compounds (D 1171 - 55) (Approved Feb. 18, 1957)

Revision and reversion to tentative.—To this method has been added an additional method of rating samples exposed to weather by providing for a quality retention rating value.

Materials for Electron Tubes and Semiconductor Devices

Tentative Method of Test for Interface Impedance Characteristics of Vacuum Tube Cathodes (F 300 - 55 T) (Approved March 6, 1957)

Revision.—In order to make this method more complete, Committee F-1 has added definitions of several of the terms used in the text such as cathode interface impedance, cathode interface resistance, and cathode interface capacitance. Specific recommendations regarding the conditions under which life tests should be performed were also added.

Federal Standard No. 151 for Testing Metals Issued by GSA—Greatly Revised

Reflects Procedures Used in Industry

A GREATLY revised Federal Standard for Inspection and Testing of Metals was issued late in 1956 as a result of intensive work under the direction of the Army Ordnance Corps, acting for the General Services Administration. The document carrying the imposing title "Federal Test Method Standard No. 151 for Metals Test Methods;" can be procured from the GSA Business Service Center, Region 3, 7th and D Sts. SW, Washington, D.C. (70 cents per copy). ASTM cooperated in revising this important standard which replaces Federal Specification QQ-M-151a.

This project has been under way for several years, and many ASTM committee members participated in a preliminary review of the earlier drafts. The ASTM Ordnance Advisory Panel, under the chairmanship of R. J. Painter, Executive Secretary of the Society, appointed in 1955 a panel of approximately 15 experts participating in ASTM committee activities to review a later draft of the new Federal Standard. An all day session was held on May 20, 1955, in Washington, at which time many suggestions of the ASTM committee members were considered. A great majority of the suggestions of the ASTM committee members were considered. A great majority of the suggestions have been incorporated in the final document.

Procedures for composition analysis, both chemical and spectrochemical, provide for the use of the applicable ASTM methods of analysis, unless a particular method is specified by the procuring agency. The ASTM charts for austenite grain size and wrought copper alloy grain size are a part of the Federal Test Method. Hardness conversion tables parallel the appropriate ASTM charts. Other procedures for measuring mechanical properties by tension, impact, bending, and hardness are very similar to the ASTM test methods. Coating tests, tests for electrical and magnetic properties, and corrosion tests are also compatible with the ASTM procedures.

In the work on standardization in both the so-called Federal Standards area, which is directed by the Standards Division of the General Services Administration, in part by means of assigning responsibility for groups of standards to various Government agencies, and the Military Standards area of the Department of Defense, there is the desire to make use of industry standards wherever applicable. Directives have been issued, as mentioned in earlier ASTM BULLETINS, covering the use of industry standards.

While the revised Federal document No. 151 does not so state nor embody direct references to many of the ASTM standards that are applicable, as indicated above the requirements are in very close accordance. In some cases, some of the Government agencies have asked that certain matters be spelled out in more detail or that slightly different techniques to be used.

Both the GSA and the Society would welcome any comments on this new document. This revised document 151 stands as an excellent example of good results that can come from Government-industry cooperation.

Beating the Bushes

IN AN editorial in the January 10 issue of *Iron Age*, Tom Campbell, a leading metallurgical editor, writes on "Beating the Bushes." He points out that products and services do not sell themselves, that we have built-in safeguards to our economy, but sometimes these are also built-in complacencies.

He continues, "You have to beat the bushes all the time for sales if you want to remain known when things are a little tougher. You have to promote continually your product or service if you don't want to become lost in the shuffle. The handmaiden to sales and promotion is lower unit cost. This comes from new equipment, modernizing present plant and improving manufacturing techniques." We are sure the editor will not mind if we add a postscript, namely, that participating in cooperative research and standards work for materials may be a very helpful lifeline, particularly in keeping costs down.

NEW ASTM PUBLICATIONS

Symposium on Tension Testing of Nonmetallic Materials

ONE OF the simplest physical tests that can be made on any material is, at first glance, a measure of the tensile pull required to break it. Perhaps it is in part this simplicity, both of concept and of execution, that has made tensile properties a common denominator in testing of material, especially in the field of metals.

Among the nonmetallic materials, however, there is such a diversity of structure and properties that a variety of methods has evolved for measurement of tensile properties. New materials have been developed for which older techniques are inadequate, new technical tools have been applied to the problem, new understanding of the structure of materials has brought a more meaningful interpretation of results and each of these factors has contributed to the terminology and nomenclature of tension testing.

The Symposium on Tension Testing, held at the 1956 Annual Meeting of the Society, was arranged by Subcommittee 4 on Tension Testing of ASTM Committee E-1 on Methods of Testing with the objective of providing: (1) an accurate summary of present practices in fields where tension testing is most widely used; (2) a critical appraisal of their merits and deficiencies; (3) an opportunity to compare techniques and terminology among the various fields; and (4) a guide to future development and standardization.

Following an Introduction by A. C. Webber, Vice-Chairman of Committee E-1, the following papers appear:

Tension Testing of Plastics—*F. W. Reinhart, National Bureau of Standards*
Tension Testing of Adhesives—*A. G. H. Dietz, Massachusetts Institute of Technology*
Tension Testing of Rubber—*H. Tangenberg, B. F. Goodrich Co.*
Tension Test Methods for Wood, Wood-Base Materials, and Sandwich Constructions—*L. J. Markwardt and W. G. Youngquist, Forest Products Laboratory*
Present Practices in Tensile Strength Testing of Paper in Industry—*John Fachet and F. T. P. Plimpton, Jr., Thwing-Albert Instrument Co.*
Summary—A. C. Webber, E. I. du Pont de Nemours & Co., Inc.

Copies of this 88-page symposium (*STP 194*) can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $2; to members, $1.50.

Report on Elevated-Temperature Properties of Wrought Medium-Carbon Steels

THE INCREASING demand for metals capable of withstanding high temperatures in nuclear reactors, jet engines, and rockets enhances the value of this report for metallurgists, engineers, and physicists.

Presented as a graphical summary of the elevated-temperature strength data for medium-carbon alloy steels, it includes summary curves for tensile strength; 0.2 per cent offset yield strength; per cent elongation and reduction in area; stresses for rupture in 100, 1000, 10,000, and 100,000 hr; and stresses for creep rates of 0.0001 and 0.00001 per cent per hr (1 per cent in 10,000 and 100,000 hr). Data for 27 steels representing approximately a dozen alloy types are given. Data for a few miscellaneous low-carbon alloy steels are also included.

This report is one of a series based on data compiled by the Data and Publications Panel of the ASTM-ASM Joint Committee on the Effect of Temperature on the Properties of Metals. Others of the series of reports are:

Elevated Temperature Properties of Stainless Steels (*STP 124*)
Elevated-Temperature Properties of Chromium-Molybdenum Steels (*STP 151*)
Elevated Temperature Properties of Selected Super-Strength Alloys (*STP 160*)
Elevated Temperature Properties of Carbon Steels (*STP 180*)
Elevated-Temperature Properties of Copper and Copper-Base Alloys (*STP 181*)
Relaxation Properties of Steels and Super-Strength Alloys at Elevated Temperatures (*STP 187*)

This latest Report on Medium-Carbon Alloy Steels (*STP 199*) can now be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $4.25; to members, $3.25.

ASTM Standards on Cement

THIS FOURTEENTH edition gives in convenient form the ASTM methods of test and specifications pertaining to cement which have been prepared by Committee C-1 on Cement. In addition to the 34 standards, the compilation also includes four appendices covering the Manual of Cement Testing, an extensive list of Selected References on Portland Cement, Information on Analytical Balances and Weights, a paper on "The Principle of the Methoxyl Method for Determining Vinsol Resin in Portland Cement," and the bylaws and personnel of Committee C-1.

The purpose of the appended Manual of Cement Testing is to emphasize those factors which may affect results of tests and to call attention to less apparent influences that are important, but which are sometimes overlooked. Recommendations do not in any way supersede the standard methods of test but supplement the physical tests and suggest procedures in certain sections and recommend methods which the committee has found satisfactory and conducive to greater uniformity.

The appended Selected References on Portland Cement list some of the better known and more important sources of information on the material. For the benefit of those primarily concerned with testing, there are a number of references to this subject.

Copies of this 272-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $3; to ASTM members, $2.25.

ASTM Specifications for Steel Piping Materials

(Pipe—Tubes—Castings—Forgings—Bolting—Welding Fittings—Grain Size)

THE TWELFTH edition of this compilation contains about 60 standards widely used and of great importance to engineers, technologists, and purchasing agents in power plants and similar installations, refineries, distribution of water, gas, oil, etc. Most of these specifications have been developed by Subcommittees IX on Steel Tubing and Pipe and XXII on Materials for High Temperature Service of ASTM Committee A-1 on Steel.

These standards can be roughly

grouped as applying to pipe, boiler, superheater, and miscellaneous tubes, still tubes, castings, forgings and welding fittings, bolting, and methods of testing.

Copies of this 466-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $4.50; to ASTM members, $3.40.

West Coast Meeting Papers

ENCOURAGING progress is being made looking toward publication of the papers presented at the ASTM Second Pacific Area National Meeting. Several have appeared in the ASTM BULLETIN and while some few have been released for publication in other technical journals, these papers for the most part will appear in Special Technical Publications issued by the Society. Some of these should be available within the next few months.

In the meantime, a limited supply of mimeograped copies of individual papers may be secured at ASTM Headquarters, 1916 Race St., Philadelphia, Pa., at 50 cents a copy.

Erratum in Yellow Sticker for Part 3, Book of Standards Supplement

A REVISION of Section 4 (*d*) of the Tentative Method of Test for False Set of Portland Cement (C 359 – 55 T), which was approved at the 1956 Annual Meeting of the Society, was inadvertently omitted from the yellow sticker distributed with the 1956 Supplement to Book of ASTM Standards, Part 3, in which the 1956 revision of Section 2 (*b*) of Method C 359 was shown.

In line 8 of Section 4 (*d*) of Method C 359, change "$2\frac{3}{4}$ min" to read "3 min."

An Apology

On page 8 of the January BULLETIN it was erroneously stated that the weathering index for brick was developed by the U. S. Weather Bureau. The weathering index was developed by Clayford T. Grimm while in the employ of the Clay Products Assn. of the Southwest. Mr. Grimm is now assistant director, engineering and technology, Structural Clay Products Inst.

ASTM STANDARDS AT WORK

Bethlehem Steel Co.

High strength bolts meeting all requirements of ASTM Specification A 325 for Quenched-and-Tempered Steel Bolts lock the steel skeleton that is sheathed in the marble, limestone, and pink granite facade of the Prudential Insurance Company's South-Central Headquarters in Jacksonville, Fla.

Use of bolting is gaining rapidly in favor as a means of erecting steelwork economically. Bolting of the 5893 ton framework of this building was completed within a week after the last piece of steel was set.

CHARLES BENJAMIN DUDLEY
1842–1909

The tremendous contributions of Dr. Dudley, first President of ASTM, in the formative years of the Society would more than justify the recurrent use of his photograph. When a new picture of him is discovered, making so far as we know, only two available, then the photograph becomes newsworthy. Here is the brief story:

Last February the Executive Secretary and the President were speaking at a joint meeting in San Francisco and immediately prior to the meeting they were handed a mysterious sealed envelope which, when opened, revealed the photograph reproduced here. Dozier Finley, longtime active member of the Society and chairman of the first West Coast meeting in 1949, had visited Chestnut Hill, a suburb of Philadelphia, in connection with the settlement of an estate. In going over an album of old pictures his attention was directed to Dr. Dudley's likeness. W. J. Latta of Chestnut Hill, whose father had been associated with Dr. Dudley on the latter's retirement from the Pennsylvania Railroad, aided in the discovery.

A very fine oil painting of the first ASTM President hangs in the Members' Lounge at Headquarters in Philadelphia. It was given to us by the Pennsylvania Railroad where Dr. Dudley was chief chemist for many years. He did much pioneering work in this field.

Each of the presidents since Dr. Dudley has made important contributions to our work, has been outstanding in his field, and has devoted great effort and long years of service to the Society.

In connection with this photograph it might be noted that the BULLETIN hopes to begin a series of pictures of pioneering men in the field of materials.

ACR Notes

FEEDBACK—A Sampling of T/C Members' Opinions

The lifeblood of ASTM is the technical committee. This month I asked several of my colleagues who are active in ASTM work to write this column, thus bringing the viewpoint of the committee, subcommittee, and section where the bulk of the research is done. Each of the authors was given background information on the Administrative Committee on Research and a green light to express freely his thoughts on research and ASTM. As you read, you will be impressed by the new jobs the authors have lined up for the ACR. You will also note that the ACR's scope and function[1] provided the writers with several themes. The authors have asked me to say "thank you" to ASTM for this opportunity to write on ASTM Research.

H. K. Nason[2]

Adams Urges Publication of Lost ASTM Research[3]

The Administrative Committee on Research periodically develops a compilation now known as "Challenges in Materials Research." Here are listed unsolved problems that concern "materials or materials testing, including methods of measuring constants and properties." This compilation is a valuable one, but, as noted by A. T. McPherson, Chairman of ACR's unsolved problems subcommittee, stimulates the initiation of a very limited number of laboratory programs. Ways of increasing the effectiveness of this listing are under active study. In the meantime, the major challenge in materials research within the ASTM frame of reference needs attention. It lies outside the technical problem area, yet squarely within the scope of the ACR. This is the challenge of searching out and bringing to the publication stage, "Lost ASTM Research."

The latest ASTM Plastics compilation carries over 140 methods and specifications. It is reasonable to assume that each of these involved the spending of many research dollars; in one instance, the dollar expenditure for research on a portion of one material specification reached approximately $25,000. The immediate product of such research is a new or revised ASTM standard. The standard summarizes the research results as a specification value, a precision tolerance, a procedure, or a description of test apparatus. It does not give the background of the method or of the experimental work leading to the precision tolerance, the apparatus, or the specification. This type of information is all too frequently lost in the files of the persons who participated in the development.

Is it important that the experimental background of a heat distortion specification for type I polystyrene be known to a larger audience than the section which did the work? Do chemists, physicists, and engineers want to know that a major ASTM interlaboratory program demonstrated that a "suspect" ten year old method was technically sound? The answer to these and related questions is a most obvious, "Yes!"

The searching out of ASTM plastics research results should be a very straightforward matter. This could very well be handled in Committee D-20 on Plastics by the Chairman of the Research Subcommittee. The next step, that of preparing the information for publication, is the difficult one. The persons who participated in the work and are therefore best qualified to report on it are very busy with their day-to-day problems. They feel that enough time has already been spent in carrying out the laboratory phase of the project. At the same time, they recognize the importance of documenting the work in the technical literature and would welcome help in getting it done.

The Administrative Committee on Research could well take this problem under advisement. It is one that is well defined and one that when solved will immediately and directly benefit the promotion of engineering knowledge and the testing and standardization technology on plastics.

Among the avenues open to the ACR in solving the problem are: (1) compile a list of "archived" ASTM plastic research results, (2) publish this in the BULLETIN, (3) encourage publication in appropriate ASTM publications (response to (2) by BULLETIN readers should be helpful in catalyzing this operation), (4) provide some incentive for publication, for example, ACR award, (5) provide editorial assistance, and (6) follow up on as personal a basis as possible. The task is formidable, but one that can net the ACR and the industry a very high return on its investment.

Bourke would Tap T/C Gold Mine of Information[4]

ASTM Technical Committees have done, and are doing, a truly remarkable job in establishing standards for materials and the measurement of their properties. We cannot begin to estimate their impact on technical progress and human welfare. The wonder of it all is that these standards evolve from the voluntary cooperative effort of consumers, producers, academic, and public service agencies.

Are we exploiting fully the potential usefulness to research of ASTM test methods? The answer is "yes," if we exercise sound judgment in adapting the method to our particular needs. The great deal of confidence placed in ASTM methods of test is well deserved but can lead to dangerously broad acceptance of them as the epitome of research evaluation practice by persons new to testing work. These people need to have available a readily accessible story on the applicability and versatility of test methods and instrumentation, together with the range of variables that can be studied and their significance.

Every ASTM method of test can be made to serve double duty. To achieve this, we must apply the same thoroughness and candor in compiling and publishing treatises on the technical background of standards, as we do in their promulgation. Whatever the origin of a standard, it undergoes a rigorous

[1] Scope of ASTM Administrative Committee on Research: "This committee has for its functions broadly (1) to consider means by which the work of the Society in promoting knowledge of engineering materials may best be advanced; (2) to encourage and stimulate investigations for this purpose under the auspices of the Society; (3) to seek to bring about studies of those properties of materials concerning which information is needed; and (4) to review annually the progress of the Society's research activities."

[2] Vice-president and general manager, Research and Engineering Div., Monsanto Chemical Co.

[3] C. H. Adams—Leader, American Group for International Standards Organization (ISO) Technical Committee on Plastics (TC 61); Chairman Sub I, Mechanical Properties, of ASTM Committee D-20 on Plastics; manager, plastic product development, Research and Engineering Div., Monsanto Chemical Co.

[4] R. J. Bourke—Member ASTM Committee D-20 on Plastics; Chairman, Section in Subcommittee X; group leader, Research Dept., Plastics Div., Monsanto Chemical Co.

experimental proving out in an ASTM round-robin program before it is proposed for adoption. From then on, the emphasis seems to be concentrated on the standard and its publication. Supporting data and conclusions rarely accompany letter ballots. The tremendous amount of well planned and executed research work which serves as a basis for the proposed standard of test rarely gets beyond task group or section meeting discussion. How often has some old timer risen in an ASTM meeting to clarify, to the best of his recollection, the mystery of the background and history surrounding a standard method of test up for revision? Thank goodness for the old timers, for, in most situations, they represent the only link with the continuity and sense of past action! There is a serious lack of documentation. ASTM Technical Committee work, over the years, represents a gold mine of information just waiting to be tapped.

Brand Notes Upsurge in Chemical Industry Standards[5]

The chemical industry has now reached the industrial stature of being the fourth largest industry in the country when considering its assets, and has woven itself into the very fiber of the nation's economy. There is scarcely a facet of our life today that has not been touched by the chemical industry—our automobiles, our homes, the clothes we wear—even the food we eat has probably been grown with the aid of fertilizers manufactured by the chemical industry and preserved by chemicals during shipment or in storage.

With this maturity has come a recognition of a vital need for a good standardization program covering the mechanical equipment and materials used in converting raw materials to finished products, and not standardization of the products themselves. That this need has been recognized in the chemical industry is exemplified by the new emphasis being placed on standards within various chemical companies. In addition and as a result of the renewed emphasis within the respective companies, the national scene is also experiencing considerable activity in this direction. Examples of this are seen in the establishment of the Chemical Industry Advisory Board of the American Standards Assn. in 1950; the establishment this past year of the Mechanical Technical Committee in the Manufacturing Chemists' Assn.; the efforts toward mitigation of industrial waste by the National Assn. of Corrosion Engineers; and dissemination of information on good painting practices through informal protective coatings societies which have been only recently organized in key industrial areas.

If standards are to be of any real value they must be based upon reliable data. In this regard the ASTM is to be heartily commended for backing up standards with factual data based on extensive research programs.

The ASTM should be commended for its alertness in keeping abreast with this new standardization activity in the chemical industry. It is represented on the ASA Chemical Industry Advisory Board where many of the standardization needs of the industry are discussed.

With all this standardization activity going on in the chemical industry, the Administrative Committee on Research can perform a useful function in bringing to the attention of the appropriate ASTM committees the research that needs to be done in support of this expanding standardization program.

Continuity of Effort Important Says Darby[6]

The eminent research men of the ACR have reviewed in previous ACR Notes the various elements contributing to successful research. One that was always emphasized was proper definition of the problem. In short, the point was made not once, but many times, that a problem without definition is really not a problem. Another requisite for successful research worthy of more emphasis is *continuity of effort* on the problem. It would be interesting to review within our own experience the number of projects that were unsuccessful simply because of discontinuity of effort—off again, on again, research.

A recent review of research work done by members of ASTM Committee D-20 on Plastics brought to light some very interesting data pertaining to the outdoor durability of plastics. For the purpose of determining whether specimens should be exposed normal to the sun's rays (for some average sun path) at each testing station latitude, a number of different plastic compositions were tested at various angles of exposure. For most of the plastic specimens, the results were not significantly different, leading to the logical conclusion that the standard 45-deg angle exposure was quite satisfactory for all test sites. In the case of plasticized vinyl plastic compositions, however, it was found that the horizontal specimens deteriorated much more rapidly than the specimens located at other angles. This was new and significant information on outdoor durability of vinyl compositions.

Without this information, vinyl floor tile for a patio might have been outdoor tested at an angle, and everyone would have been misled. The testing error would have been a serious one. Now that we have the practical research result, more basic research is needed to answer the following questions: (1) Is there a possibility that more damaging sunlight actually falls on a specimen located horizontally? (2) How does ultraviolet light intensity vary with angle? (3) What is the effect of water extraction of plasticizers and stabilizers when compositions are located horizontally?

The outdoor durability of plastics is a problem of broad general interest and one which has been worked on by many individual laboratories. It would now appear advisable to coordinate the work and initiate a research program on a continuing basis. The suggestion is made that ACR arrange a minimum-cost fellowship with a qualified academic researcher. ASTM members from the appropriate technical committees could guide the work by contributing their experience and suggestions to the over-all program. The ACR would thereby establish a continuity of effort with all its attendant benefits. Such a contribution to the industry via the ACR might move forward by 10 to 20 years the date when many plastics could be used out of doors.

Ingle Believes Undergrad Research Feasible[7]

The mere listing of unsolved problems by the ACR, now known as "Challenges in Materials Research," is, it seems, a rather ineffective way to activate programs. It amounts to requesting voluntary research on the part of people who already have a great deal to do.

Progress toward solution of these unsolved problems will require additional research effort preferably by direct sponsorship and supervision by the appropriate committee. One of the elements in the project's worth must be its dollar value. (The kinds of problems listed by Committee E-12 on Appearance are of more commercial than fundamental value, although not entirely lacking in this respect.) Accordingly, Committee E-12 could and should en-

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[5] D. C. Brand—ASTM Representative on ASA Chemical Industry Advisory Board; coordinator of standards, Engineering Dept., Research and Engineering Div., Monsanto Chemical Co.

[6] J. R. Darby—Member, ASTM Committee D-20 on Plastics, Subcommittees III Thermal, V Permanence, X Definitions; group leader, Research Dept., Organic Div., Monsanto Chemical Co.

[7] G. W. Ingle—Vice-Chairman, ASTM Committee E-12 on Appearance; Past-Chairman Subcommittee IV, Optical Properties, Committee D-20 on Plastics; section leader, Research Dept., Plastics Div., Monsanto Chemical Co.

list the dollar support of those groups represented in other ASTM committees with interest in application projects. Furthermore, it seems from my few recruiting travels that there are students in liberal arts colleges, and possibly some in engineering schools, who could be interested in working on these problems, particularly if there were some small dollar stipend attached. An important factor here would be the management of the work done by these students—management which would have to be supplied by a steering committee headed by Committee E-12 and obviously including one or more of the students' instructors.

The fruits of this second alternative are obvious. Not only should some good work be done, if properly managed, in small increments, but also the work itself might prove an influence in directing the students to a technical career. Obviously, there are a number of problems involved in such a sponsored research program, but these could probably be solved if Committee E-12 supplies the proper leadership.

It might well be that this approach is more appropriate for an Administrative group such as Committee E-12 rather than for a group which is predominately technical such as Committee D-20 on Plastics. I refer here to the fact that there are within Committee E-12 a greater proportion of technical personnel managing or doing research work on specific problems. It is my opinion that the basic idea of buying incremental research of the undergraduate through proper management, guidance, and assistance is broadly feasible.

Palmer Sees No Shortage of Problems[8]

The preparation and evaluation of surface coatings date back to the time of the pyramids when the Egyptians made the first so-called water paints by mixing lime, glue, and earth colors, with evolution to date progressing more along the line of an art than a science. How much an art many of our methods of evaluation really are was brought out with shocking clarity during a session of Subcommittee VIII of ASTM Committee D-1 on Paints during its February meeting. In the course of this meeting, analytical results submitted by 85 different laboratories on four selected paint samples were examined. On such a standard determination as per cent nonvolatile, variation between reported high and low by the various laboratories amounted to from 5 to 25 per cent of the quantity of material actually present. This type of variation was evidenced in other supposedly simple measurements.

The field of surface coatings has many unsolved problems of evaluation like the one described above plus many others dependent on the human element. Many of our tests rely on visual rating of performance. The eye is a wonderful machine and can analyze small differences when standards for comparison are available. Without comparison standards the reproducibility of even a single operator's measurements over an extended period of time—let alone between different operators and laboratories—leaves much to be desired. Considerable progress is being made by the numerous ASTM committees and subcommittees in the establishment of comparison standards and the development of mechanical means of measurement not dependent on the human element.

To one engaged in research on new and improved surface and protective coatings the accomplishments of the ASTM committees in the preparation of concise and reproducible test procedures are a real asset. However, the surface has just been scratched. In the line of evaluation alone, there remain numerous unsolved problems. One of these problems for which we all wish an early solution is accelerated weathering in its broadest sense. We have many accelerated tests, but in the final analysis we are still confronted with the necessity of placing a test specimen out for actual field performance evaluation. Even then a high degree of uncertainty prevails. If the exposure was out of doors, the vagaries of weather from season to season, year to year, and place to place must be somehow compensated. Interior exposures are no less a problem for there is no standard home, office, store, or factory.

Whitney Suggests Intersociety Research Committee[9]

Because of the tremendous diversity of construction materials and the magnitude of industrial uses to which they may be applied today, successful technical committee operation is more important than ever. For this reason, individual society committee activity may be a thing of the past and intersociety committees the standard of the future. Committee liaison is not enough—active participation is required. The importance of a problem to be undertaken can be gaged perhaps by the willingness of the industries concerned to finance the solution. The project may be placed directly with an educational or research institution which may insure procurement of data more rapidly than by the volunteer method. In addition to timing there may be another merit—conservation of manpower. The method may make more effective use of our technically well trained and talented men of which there is a critical shortage.

The development of data whether by society or intersociety committees, to be effective, must operate under unit control. In the case of single society activity it suggests a greater responsibility in administration. It will be insufficient simply to define the problem and its objectives. It will require an accurate cost estimate of the work, a time schedule to satisfy the sponsors, procurement and administration of funds, and close attention to the work to insure completion of the objectives on time. In the case of intersociety activities the importance of an administrative group such as an Intersociety Committee on Research[10] is envisioned. Among the many aspects which will confront such a group, two are outstanding: (1), to draw up and administer a set of rules by which intersociety committees may operate best; and (2), to ascertain and assist in the provision of manpower that can most aggressively promote and conduct the work. The latter applies not only to the present but to the future.

It is natural to want to place research projects with institutions of great reputation and known talent. But these institutions may already be overloaded. Hence, many pieces of work are deferred or revert to volunteer handling. Consider an aggressive approach to placing projects with the lesser known but equally potentially talented sources —the smaller colleges and universities, the newer technical laboratories, consulting firms, and foundations. Extensive placement of projects in the smaller schools will go far to provide the important by-products of opportunity and incentive for technical and research training. Also, it will provide competition among existing facilities which should lead to an upgrading of the U. S. research plant.

[8] J. F. Palmer—Voting Member ASTM Committee D-1 on Paints, Subcommittees IX and XI; member Committee D-20 on Plastics, Subcommittee XVIII, Reinforced Plastics; group leader, Research Dept., Organic Div., Monsanto Chemical Co.

[9] F. L. Whitney, Jr.—Member of ASTM; manager, Corrosion Section, Engineering Dept., Research and Engineering Div., Monsanto Chemical Co.

[10] EDITORS NOTE.—The Engineering Foundation and The National Research Council among others, are active research coordinating groups.

ASTM Bulletin

APRIL 1957

NO. 221

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Who, Me?

THAT ALL depends. If you are a non-member of the Society, serving on one or more of its technical committees—by all means. Or if you are a longtime member but know some one of your associates who would benefit by keeping in touch with the Society and its operations, this article is also intended for you.

Every year, knowing the necessity for keeping all committee members informed, at least one issue of the ASTM BULLETIN is sent to all irrespective of whether membership is held in the Society. This is the issue that is receiving this wider distribution. But it would be far better if this contact were continuous, either through a subscription to the BULLETIN, or through membership which, of course, brings the BULLETIN regularly as one of the benefits of membership. To us, service on a committee is much more meaningful if it is recognized where the work of that particular committee fits into the operations of the Society as a whole. What is the relation of the work of this committee to that of all the others? How do these other committees carry on their work? What happens to the product of the committees? What publications are there? How could my organization benefit from Society work other than that of this immediate committee?

Many individuals are chosen by their organization to serve on a particular committee because of their special knowledge. A job is to be done from which industry will benefit. That is the immediate aim—to foster the work of that particular committee. It need not, nor should it be, the sole aim. The job can be done better by having a broader knowledge of the working of the Society as a whole. And we would venture to predict that a better accounting could be made to management of the time spent if a statement were included of its broader significance. The best way to accomplish this, of course, is through personal membership in the Society—the next best, through a subscription to the BULLETIN.

To the Editor:

DEAR SIR:

When authors submit papers describing investigations in which X-ray powder measurements were made, but omitting the actual X-ray data, it is requested that these data be submitted to the Editor of the Joint Committee on Chemical Analysis by Powder Diffraction Methods for possible inclusion in the "X-ray Powder Data File," published by the ASTM.

The data should contain accurate listings of "d" values and intensities of reflections. Other items of information of value for the data file are: hkl indices and lattice parameters if known, radiation used, type of X-ray recording employed, method of estimating intensities (visual, photometric, geiger-counter), plus any relevant information concerning the nature and preparation of specimens studied.

G. W. BRINDLEY
Editor,
"X-ray Powder Data File"
The Pennsylvania State University
University Park, Penna.

SOCIETY OFFICERS NOMINATED

ASTM President, Vice-President, and five Directors, were named by the Nominating Committee at its meeting at ASTM Headquarters in Philadelphia on March 8, 1957. In accordance with the bylaws of the Society, the committee announces the following nominations:

For President (1 year term):

R. T. Kropf, vice-president and director of research, Belding Heminway Co., Inc., New York City.

For Vice-President (2 year term):

F. L. LaQue, vice-president and manager, Development and Research Division, The International Nickel Co., New York City

For Directors (3 year term):

C. L. Clark, metallurgical engineer, Special Steel Developments, Timken Roller Bearing Co., Steel and Tube Division, Canton, Ohio

A. E. Juve, director, Technical Service, The B. F. Goodrich Research Center, Brecksville, Ohio

J. H. Koenig, director, School of Ceramics, Rutgers University, New Brunswick, N. J.

R. E. Peterson, manager, Mechanics Department, Westinghouse Electric Corp., Research Laboratories, Pittsburgh, Pa.

R. W. Seniff, manager of research, The Baltimore and Ohio Railroad Co., Baltimore, Ohio

The bylaws provide that "further nominations, signed by at least 25 members, may be submitted to the Executive Secretary in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

ASTM and ASA Advisory Committees to National Bureau of Standards Meet Jointly

THE ASTM and ASA Advisory Committees to the National Bureau of Standards met recently at the National Bureau of Standards to review testing activities of the Bureau and to make recommendations as to goals that should be sought in the areas of calibrations, standard samples, test methods, product testing, and related service activities.

Dr. A. V. Astin, the Director of NBS, stated that broadly the Bureau's objective in these areas is to develop and promote the use of those standards of measurement that are needed by science and industry. He stressed that the Bureau should concentrate its efforts and resources on those services which it is in a unique position to render. For example, the primary aim should be to provide master or reference standards which are themselves used to calibrate other standards or operating instruments. Other laboratories should be encouraged to calibrate their own working and shop standards against the master standards provided by the Bureau.

In the field of product resting, Dr. Astin felt that the Bureau should emphasize its statutory functions for the development of methods of test and for cooperation with public and private standardizing organizations in the preparation of codes and specifications.

Dr. Astin reported that while formerly all fees collected by the Bureau were deposited in the Treasury, Public Law 940 of the 84th Congress now permits the Bureau to reimburse the cost of doing the work by the fees collected. This and other changes in fiscal arrangements have given greater flexibility in meeting the needs for services and have already enabled the Bureau to expand considerably its work on standard samples.

Following the meeting with the Director and members of the Bureau's Staff, the Advisory Committees met in a joint executive session and adopted the following resolutions:

1. It is the sense of these committees that the statement of objectives of service activities as outlined by Dr. Astin be endorsed.
2. That the procedures employed by the Bureau in the certification, standardization, and preparation of standard samples be published in order to implement the foregoing policy.
3. While the above program as endorsed would be sufficient for the moment the services to the cement industry through the Cement Reference Laboratory should be continued.
4. No change in the traditional product testing which has been going on should take place without consultation with the industries concerned.
5. Now that NBS is able to put testing and calibration on a self-supporting basis, these Committees urge that NBS establish sufficient facilities and personnel in order to render prompt service in these fields. Furthermore, if NBS determines it desirable or necessary, that fees be adjusted in order to expedite this service.

It is the opinion of the Committees that a reasonable time for the certification or standardization of standard commodities by the Bureau be not in excess of 60 days and that under no circumstances should it take longer than 90 days unless special test conditions require otherwise.

6. That the Bureau be encouraged to develop versatility in its personnel and shift them around as the workload might vary from time to time, and furthermore that they be encouraged to work with industry and secure loans of industry personnel on tours of duty on a no-charge basis and to make loans of Bureau personnel so that the maximum development of people and interchange of information be encouraged between the Bureau and industry.
7. In order that the services be not rendered sterile for want of research and learning and that research be not academic for want of practical objectives, it is the sense of the Committees that a proper balance be maintained between the two functions.
8. In order that standardization, particularly in the field of building codes, may be the product of adequate research rather than the result of compromise, it is suggested that the NBS examine the desirability of establishing further research activities in the field of building. We cite in this the Building Research Station of England as a possible example of the activity which the Committees have in mind.
9. The Committees welcomed the news that the Bureau was contemplating new facilities which would allow it to regroup its operations in such a way that it would greatly simplify its operations and improve its effectiveness. It is the hope of the Committees that the new establishment planned for NBS will provide the flexibility necessary to maintain the proper balance (and coordination) between research and services so that both functions may be expanded to take care of the ever-growing technical needs of the country.
10. The Committees commend the work and the program of the Bureau, welcome the opportunity to study and participate in its activities, and will welcome any future opportunity to be of service.

Representing the National Bureau of Standards at the meeting were Dr. A. V. Astin, director; Dr. A. T. McPherson, associate director; and other members of the National Bureau of Standards Staff, including Douglas E. Parsons, chief, Building Technology Division and an ASTM Director. Members of the ASTM Advisory Committee who attended the meeting were President R. A. Schatzel, vice-president and director of engineering, Rome Cable Corp., A. Allen Bates, vice-president of research and development, Portland Cement Assn.; A. W. Fisher, president, Fisher Scientific Co.; and R. E. Peterson, manager, Mechanics Division, Westinghouse Electric Corp., Research Laboratories. Executive-Secretary R. J. Painter also was present. Members of the ASA Advisory Committee present were H. T. Hallowell, Jr., president, Standard Pressed Steel Company, president, ASA; A. S. Johnson, vice-president and manager, Engineering Dept., American Mutual Liability Insurance Co.; Vice-Admiral G. F. Hussey, Jr., managing director, ASA; and Cyril Ainsworth, technical director, ASA.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
May 2	Committee C-20 on Acoustical Materials	New York, N. Y. (ASA Headquarters)
May 3	New England District	Kingston, R. I. (Univ. of Rhode Island)
May 20–24	Committee E-14 on Mass Spectrometry	New York, N. Y. (Commodore Hotel)
June 16–21	**Annual Meeting**	**Atlantic City, N. J. (Chalfonte-Haddon Hall)**
July 12	Joint Committee on Chemical Analysis by Powder Diffraction Methods	Montreal, Quebec, Canada
October 6–10	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C. (Sheraton-Park Hotel)
October 6–10	Joint ASTM-TAPPI Committee on Petroleum Wax	Washington, D. C. (Sheraton-Park Hotel)
October 9–11	Committee E-6 on Methods of Testing Building Constructions	Ottawa, Ontario, Canada (National Research Council)

The Northern California District Council gathered to hear President Schatzel. Standing left to right, they are: G. J. Grieve, District Secretary; C. H. Fitzwilson; Victor S. Decker, a visitor; W. W. Moore; R. A. Kinzie, Jr.; R. W. Harrington, District Vice-Chairman; L. A. O'Leary: R. E. Davis; M. C. Poulsen; T. K. Cleveland; E. W. Gardiner; and Executive Secretary R. J. Painter. Seated: Dozier Finley, Honorary Member; H. A. William; Roy Henning; P. E. McCoy, District Chairman; President Schatzel; P. V. Garin, ASTM National Director; T. Parker Dresser, Jr.; and W. N. Lindblad.

District Activities

President Schatzel Completes Tour of Southern and Western Districts

Accompanied by Executive Secretary the ASTM President Speaks on Materials for Electric Power Transmission

Northern California District . . .

A good turnout of about 100 representatives of ASTM and the Golden Gate Chapter of the American Society for Metals greeted Rudolph A. Schatzel, vice-president and director of engineering, Rome Cable Co., at Spenger's Grotto in Berkeley. Chairman W. C. Mathewson and Vice-Chairman R. M. Beard of ASM turned the meeting over to Paul McCoy, ASTM District Chairman, who introduced Executive Secretary Painter, the coffee speaker. Mr. Painter posed the question "Are Research and Standards Related?" His affirmative answer was strongly corroborated in Dr. Schatzel's discussion of the research and standardization problems encountered in the production of electric cable.

Southern California District . . .

This Lincoln's Birthday meeting in Los Angeles was the first in many years to be sponsored solely by the Southern California District. Because of the subject of Dr. Schatzel's talk, members of the AIEE and ASM were invited, and there were a goodly number of men from these two groups in the 110 who attended.

A special feature of this meeting was the presentation by the president of student membership awards to seniors from the University of Southern California and the University of California at Los Angeles. These awards are sponsored by ASTM members in the area and several more to students of California Institute of Technology will be made at a later date. District Chairman M. B. Niesley presided.

San Francisco—

Local ASM officers and Executive Committee members at the joint ASM-ASTM meeting to hear the ASTM President. Seated, left to right: E. W. Milburn, treasurer; W. C. Matheson, chairman; H. E. Krayenbuhl, secretary; R. M. Beard vice-chairman. Standing: E. R. Babylon, W. J. Erickson, Robert Nicholas; T. M. Swanson, R. L. Ray, Jack Washburn, L. E. Habben, M. W. Kawheuchi, and Sutherland Hutton.

The head table at the Southern California District meeting. Seated, left to right: J. B. Howe, District Secretary; President Schatzel; M. B. Niesley, District Chairman; Executive-Secretary Painter; Barney Friedman, Standards Engineers Society. Standing: Max Dunn, local chairman, American Chemical Society; Frank Wilby, program chairman, SES; J. E. Wilson, vice-chairman, American Society for Metals; Loren Neff, local secretary, ACS; Jack Dickason, chairman, ASM.

Among those who received Student Membership Awards from the Southern California District were: seated, left to right, J. A. Allison, R. A. Chambers, M. A. Pescara, A. J. Thompson, W. R. Paxton, W. C. Hauser. Standing, C. Elias, Jr., C. L. Bose, T. L. Ellis, S. E. Dunin, P. D. Thomas, C. T. Stelzried, and M. J. Weiner.

Southwest District—New Orleans

Dr. Schatzel's visit was the second time that an ASTM president had attended a District meeting in New Orleans. Arrangements were made by G. E. Goheen, Southern Utilization Research Board, who is program chairman of the New Orleans Section of the American Chemical Society. The New Orleans Section of the AIChE was also invited.

Following dinner at Delmonico's, the group adjourned to a lecture hall at Tulane University to hear Dr. Schatzel. Father H. R. Jolly of Loyola, local ACS chairman, presided and introduced J. R. Tusson, local AIChE chairman. There were about 50 present at this meeting.

The ladies who attended the Los Angeles meeting. Seated, left to right they are: Mrs. R. J. Painter, Mrs. W. C. Hanna, Mrs. R. A. Shott. Standing, Mrs. Myron Niesley, Jr., Mrs. Byron Weintz, Mrs. Myron Niesley, and Mrs. W. M. Barr.

Southwest District—Houston . . .

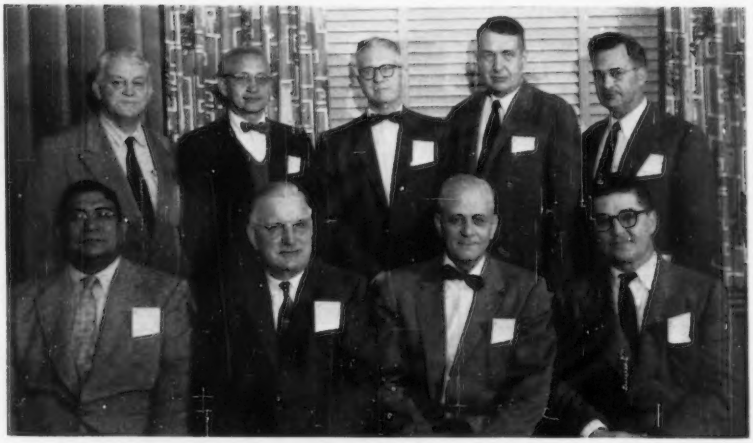
This meeting, held at the University of Houston, was preceded by a dinner. P. L. DeVerter, District Chairman,

At the New Orleans meeting of the Southwest District were, left to right: ASTM Executive Secretary Painter; G. E. Goheen, local program chairman, American Chemical Society; J. R. Tusson, local chairman, American Institute of Chemical Engineers; Rev. H R. Jolly, local chairman, ACS; and ASTM President R A. Schatzel

presided, and the technical program was arranged by Earl Berkeley with the cooperation of Blake Manuel and Frank Chairez. Attendance about 50.

In Houston, as at Los Angeles, Dr. Schatzel made student membership awards to outstanding students at the University of Houston and Rice Institute on two separate occasions. At these two meetings the president commented on a Rome Cable Co. film "Cable—Pathway to Power" which shows the evaluation and testing of materials going into cable, noting that the specifications and tests were ASTM standards.

While in Houston the two officers attended the Engineers Week Banquet honoring the Engineer of the Year, John Marion Nagle, who is Director of Houston's Department of Public Works and Engineering and represents his Department's membership in the Society.



The Southwest District Councillors photographed in Houston with the national officers. Seated, left to right: Frank Chairez, District Secretary; President Schatzel; P. L. DeVerter, District Chairman; and H. E. Bovay, Jr. Standing: C. S. Wilson, District Vice-Chairman; J. E. Russell; Executive Secretary Painter; Past-Chairman M. E. Holmberg; and C. E. Berkeley.

Southwest District—Dallas . . .

Southern Methodist University was the site of this meeting, jointly sponsored by the Industrial Division of the North Texas Section of the AIEE. Professor John Savage, chairman of that group, arranged the program. The audience of about 60 included engineering students, faculty, (among them Prof. Tatum, head of the Electrical Engineering Dept. and Engineering Dean Spath) and leading engineers of the area. Vice-Chairman Edwin Joyce, American Petroleum Inst., represented the District Council.

Following a brief talk by Executive Secretary Painter, covering some of the highlights of ASTM purpose and activities, during which he again stressed the importance of cooperative work to avoid duplication of effort, Dr. Schatzel awarded student memberships to the four students who were present out of the five recognized by the University.

At the Dallas meeting of the Southwest District, the ASTM national officers confer with the men who sparkplugged arrangements for the program at Southern Methodist University. Left to right: Executive Secretary R. J. Painter, Edwin Joyce, District Vice-Chairman; President Schatzel; and Professor John Savage of SMU, Chairman of the Industrial Div. of the local AIEE Section.

The Richland meeting yielded an unusual picture of local officers of seven cooperating technical societies. They are: seated, left to right, R. A. Rohrbacher, chairman, Instrument Society of America; N. T. Hildreth, secretary, ISA; R. E. Johnson, vice-chairman, American Institute of Chemical Engineers; ASTM President Schatzel; R. C. Hoffman, chairman, American Institute of Electrical Engineers, D. W. McLenegan, member of ASTM. Standing, L. L. Burger, chairman-elect, American Chemical Society; R. H. Rector, chairman, American Society for Metals; ASTM Executive-Secretary R. J. Painter; A. G. Blasewitz, chairman, AIChE; H. W. Heacock, program chairman, American Society of Mechanical Engineers; W. E. Cawley, ASME; Milton Lewis, chairman, ACS; R. B. Socky, vice-chairman, ASM; and P. S. Kingsley, ASM.

In connection with a condensed version of his talk, Dr. Schatzel showed the Rome Cable Co. film.

Richland, Washington . . .

Following a precedent established in recent years, this meeting was sponsored jointly by several cooperating chapters of national societies located in the Columbia Basin. These included: ASM, ASME, AIChE, ACS, ISA, AIEE, and ASCE. Some 100 technologists in the area attended the meeting.

Richard B. Socky, ASM vice-chairman, efficiently handled the program, and D. W. McLenegan, official representative of the ASTM membership, presided. John Rector, ASM chairman, opened the meeting. The ASTM officers conferred with Messrs. Johnson, Beaton, and Parker, plant officials of the Hanford Operation and visited the "hot" metals laboratory directed by Louis Turner. Many ASTM activities are of definite interest to Hanford, and it is felt, as work expands, particularly in nuclear energy and radioactive isotopes, great contributions can be made by Hanford personnel.

University of Idaho—Washington State . . .

More than 100 engineering students and faculty members of the Universities of Idaho and Washington State attended a joint meeting in Moscow, Idaho, to hear President Schatzel and see the film on cable. Idaho's Engineering Dean Jantzen presided, and Washington State's faculty was officially represented by Professor Moore (civil engineering) and Howard Barlow, director of Washington State's Institute of Technology. Arrangements for the meeting had been made by Professor

ASTM President R. A. Schatzel addressing the joint engineering meeting in Richland, Wash.

At the St. Louis District meeting held jointly with the Missouri Society of Professional Engineers, were, left to right: ASTM Executive Secretary Painter; Walter Rathell, past president, MSPE; Howard Nason, past ASTM National Director; J. T. Heard, president, MSPE; J. M. Wendling, ASTM District Chairman; ASTM President R. A. Schatzel; O. J. Ruel, secretary, MSPE; Gene Butler, treasurer, MSPE; and J. R. Romig, ASTM District Secretary.

N. F. Hindle, head of mechanical engineering at Idaho.

The ASTM officers toured both campuses and were impressed by their fine facilities and the alert interest of the faculty and students.

ST. LOUIS

ASTM President R. A. Schatzel and Executive Secretary R. J. Painter were the speakers at a joint meeting in St. Louis on January 22, of the Missouri Society of Professional Engineers and the ASTM St. Louis District. Both groups have looked forward each year to this cooperative event, and this particular session maintained the high plane of interest that has been developed.

Dr. Schatzel gave his District address dealing with materials for electric power distribution. The MSPE President, John T. Heard, Nooter Corp., presided. The officers of both groups were introduced, including ASTM District Chairman J. M. Wendling, City of St. Louis, Municipal Testing Laboratory; and Secretary J. R. Romig, Missouri Portland Cement Co.

Executive Secretary Painter's brief talk was entitled "Are Research and Standards Related?"

Present at the meeting was Howard Nason, vice-president, Monsanto Chemical Co., a former ASTM National Director. The attendance figure of about 70 was good considering the layer of ice and snow that descended late in the afternoon. The St. Louis District has fared badly with the weather at some of its meetings. In recent years, Past-President Markwardt spoke there in the midst of a hurricane which uprooted trees and tore down buildings and signs, and at another meeting the downpour of rain was considered the heaviest that ever hit St. Louis.

The District officers, including Vice-Chairman W. C. Magruder, Carter Carburetor Co., had brief conference with the Executive Secretary concerning the Society's 1958 Spring Meeting and Committee Week which will be held in St. Louis the week of February 9. It is rumored the local men were considering a guarantee that there would be no violent storms.

NEW YORK

Over 100 engineers and scientists attended the New York District Meeting, March 14, at which Dr. Rudolph A. Schatzel, President of ASTM, spoke. Illustrating his lecture "Materials for Electric Power Transmission" with numerous slides, Dr. Schatzel covered the three main materials used in cable and wire production. He discussed the details of metal conductors, insulating material, and sheaths.

Dr. Schatzel was introduced by A. A. Jones, Program Chairman and a Vice-Chairman of the New York District. Preliminary remarks were made at the meeting by R. J. Painter, Executive Secretary of the Society, who discussed the rapid growth of ASTM. He illustrated his discussion with some figures on pages of standards and membership for the past decade.

PHILADELPHIA

Honoring thirty engineering and science students from eleven schools in the Philadelphia District, more than 150 members and guests of ASTM participated in a program at Lehigh University on March 21. The award of a year's student membership was presented to each student by President R. A. Schatzel.

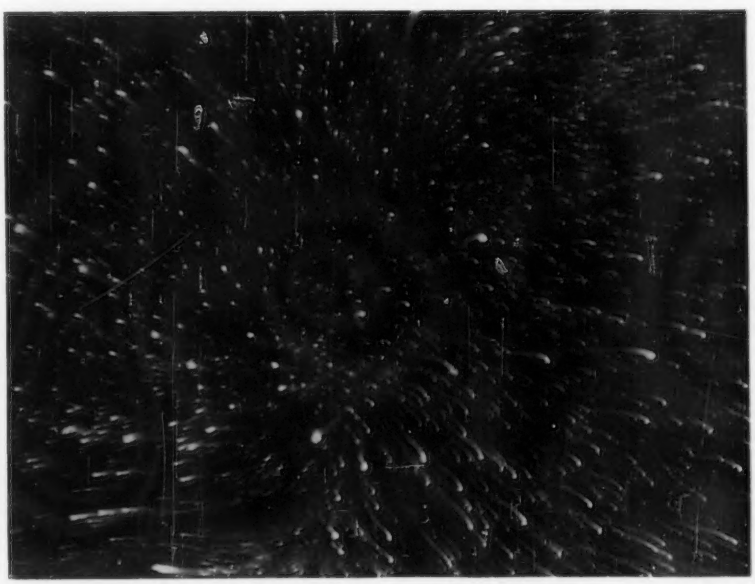
Highlight of the tour of the Fritz Engineering Laboratory which preceded dinner, was the loading to failure of a steel 16-in.-wide flange column in the 5,000,000-lb universal tester. The column buckled at a total load of 2,600,000 lb.

At the dinner, attended by 130, professors from the eleven participating schools were introduced together with Dean Bewley of the Lehigh School of Engineering, and other guests.

Dr. Schatzel presented the awards to the students as they were introduced by Tinius Olsen, II, chairman. Those receiving the awards were: D. O. Fairley and J. J. Paugh of Bucknell University; Robert Weller and J. N. Zaiser of University of Delaware; Paul Badame, Ellwood McGrogan, J. A. Segletes, William Yeniscavich, R. C. Stiefel, H. M. Hermanns and P. J. Humanick of Drexel Institute of Technology; R. D. Cziffer and J. P. Smith of Lafayette College; J. E. Brokloff, T. D. Dudderar, W. D. G. Murray and E. V. Wright of Lehigh University; E. Penski and E. G. Sielewicz of Philadelphia Textile Institute; H. P. Colhoun and W. G. Culin of Princeton University; T. O. Maher of Swarthmore College; J. T. Threston and R. J. Travia of Villanova University; and Herbert Feinroth, W. D. Germond, Jr., L. M. Magid, R. L. Novak, M. M. Shralow and J. J. Zuckerman of the University of Pennsylvania.

Dr. Schatzel concluded the program with his District talk "Materials for Electric Power Transmission."

Program arrangements were under the direction of Prof. J. B. Hartman, head of the Mechanical Engineering Department of Lehigh University.



Spontaneous Spreading of Hexadecanol-Talc Mixture on Water Surface. *Second Prize, General Photographs, black and white*—Tenth ASTM Photographic Exhibit. Wilbourn M. Batts, Commissioner's Office, Bureau of Reclamation, Denver, Colo.

New ASTM Committee on Sorptive Mineral Materials Organized

Sorptive mineral materials is the latest field of standardization entered by ASTM. A new technical committee, titled C-23 on Sorptive Mineral Materials, held its organization meeting on February 5. The decision to establish this technical committee is the result of extensive contacts with industry covering a period of well over a year. E. F. Parker, General Electric Co., was Chairman of the Steering Committee during the organizational period and acted as Temporary Chairman at the organizational meeting.

The scope of the new committee includes "the definition of terms and the formulation of test methods covering sorptive mineral materials used for surface maintenance and safety and the stimulation of research to accomplish the foregoing purposes." Initially the scope of the committee will be limited to the field of maintenance and safety materials. It is anticipated that once standard methods of tests have been developed in this field it may be feasible to expand the activities of the committee to other related fields.

The initial effort in developing standard test methods will be the compilation and review of existing methods used in industry. Such test methods as the ball mill, Rotap hardness, shaking, and stirring tests are among those which will be reviewed. The two primary properties requiring attention will be sorptive qualities and wear properties of mineral materials. A principal objective is to establish correlation of laboratory tests with performance.

Additional consumer representation on the committee is desired. Anyone interested in the activities of the committee, either from the producer or consumer point of view, may contact ASTM Headquarters for information.

The newly elected officers of the committee are:

Chairman—A. C. Balden, central engineer, Chrysler Corp., Detroit, Mich.

Vice-Chairman—C. Y. Haas, manager of adsorbent sales, Minerals & Chemicals Corporation of America, Menlo Park, N. J.

Secretary—Robert L. Shirley, national sales manager, Celatom Products Dept., The Eagle-Picher Co., Cincinnati, Ohio.

Subcommittee chairmen appointed were H. M. Gwyn Jr., Magnet Cove Barium Corp., as Chairman of Subcommittee I on Definitions and Nomenclature, and M. G. Kramer, Wyandotte Chemicals Corp., as Chairman of Subcommittee II on Sampling and Testing. The committee will hold its next meeting during the 1957 Annual Meeting of the Society in Atlantic City, N. J., during the week of June 17.

Always an important event in the Society is the advent of a new committee carrying standards work into new areas of technical activity. Pictured above is the organization meeting, held during Committee Week, of the newest committee, C-23 on Sorptive Mineral Materials.

The initial membership of Committee C-23 on Sorptive Mineral Materials follows:

Producer	Representative
The Diversey Corp.	N. W. Berst
Eagle-Picher Co.	A. G. Holler
	R. L. Shirley
	J. E. Fennell
Floridin Co.	J. W. Moore
	G. C. Jones
Great Lakes Carbon Corp.	P. W. Leppia
	F. L. Shea
Johns-Manville Corp.	H. L. King
Magnet Cove Barium Corp.	H. M. Gwynn, Jr.
Minerals & Chemicals Corp. of America	C. Y. Haas
	A. P. Allegrini
Waverly Petroleum Products Co.	E. W. Coogan
Whittaker, Clark & Daniels, Inc.	A. J. Gitter
Wyandotte Chemicals Corp.[1]	W. T. Young
	M. G. Kramer
Consumer	
Allis-Chalmers Manufacturing Co. (consulting)	W. F. Scholtz
Chrysler Corp.	A. R. Balden
Ford Motor Co. (consulting)	S. R. Thomas
General Motors Corp., Detroit Transmission Div.	J. E. Vradenburg
The Maytag Co. (Consulting)	R. V. Perry
National Biscuit Co.	C. B. Curtis
U. S., Dept. of the Army, Quartermaster Corps	J. L. Barron
U. S. Steel Corp., National Tube Div.	H. F. Skerrill
Wyandotte Chemicals Corp.[1]	W. T. Young
	M. G. Kramer
	V. R. Deitz
General Interest	
National Bureau of Standards	

[1] Also consumer.

Committees Meet in Philadelphia to Shape Up Standards Recommendations for Annual Meeting

THIRTY-FIVE of ASTM's technical committees held 300 committee and subcommittee meetings in the course of the Society's annual Committee Week held this year at the Benjamin Franklin Hotel in Philadelphia, February 4 to 8. During the five days of meetings, 1311 men registered for participation in the committee discussions. Main tasks before the committees were to put in final shape new tentatives and revisions of tentatives and standards which will be recommended to the Society for approval at the Annual Meeting in Atlantic City in June. Committee recommendations are subject to letter ballot of the committee prior to submission to the Society for action at the Annual Meeting.

Symposium on Thermal Insulation Stirs Active Discussion

A three-year research project in the effect of moisture on thermal insulation, carried out at Pennsylvania State University under the sponsorship of ASTM Committee C-16 on Thermal Insulating Materials, gave the impetus to development of the highly successful symposium that constituted the technical feature of the 1957 Spring Meeting.

The Symposium on Thermal Conductivity Measurements and Applications of Thermal Insulations was well received and well attended. The seven papers, dealing with moisture effect and the guarded hot plate apparatus, generated lively extemporaneous discussion. The symposium was developed by a subcommittee of Committee C-16 under the chairmanship of Harry Robinson, of the National Bureau of Standards, and was ably presided over by C. B. Bradley, Johns Manville Corp.

Titles and authors of the papers which will be published by the Society late this year, are:

An Improved Guarded Hot Plate Thermal Conductivity Apparatus with Automatic Controls—Zeno Zabawsky, Armstrong Cork Co.

The Use of Envelope Type Cold Plates in Thermal Conductivity Apparatus—C. F. Gilbo, Armstrong Cork Co.

Unbalance Errors in Guarded Hot Plate Measurements—William Woodside and A. G. Wilson, National Research Council of Canada

Analysis of Errors Due to Edge Heat Loss in Guarded Hot Plates—William Woodside, National Research Council of Canada

Thermal Conductivity of Insulation Containing Moisture—F. A. Joy, Pennsylvania State University.

Criteria for Testing Thermal Insulation for Use on Underground Piping—D. D'Eustachio, Pittsburgh Corning Corp.

Stress Corrosion Cracking of Insulated Austenitic Stainless Steels—A. W. Dana, E. I. DuPont de Nemours & Co., Inc.

The Pause That Refreshed

A recess from intensive work was provided by the Philadelphia District who acted as hosts at a dinner and entertainment at Philadelphia's world-renowned Franklin Institute. More than 200 attended the dinner in Franklin Hall, at which Tinius Olsen II, Chairman of the Philadelphia District, presided.

Following dinner, the members enjoyed "A Night with the Stars" in which John W. Streeter, assistant director of the Fels Planetarium and science news commentator for radio station WHYY, demonstrated the use of the Zeiss Planetarium Projector and dramatically showed the relationships between time, space, and movement of heavenly bodies.

Present at the dinner were two Past Presidents of the Society—A. C. Fieldner who was President in 1936, and L. J. Markwardt, who held office in 1950.

Following is a brief summary of recent technical committee meetings. Unless otherwise indicated, the meetings were held in Philadelphia during Committee Week.

Steel

ALTHOUGH there were many and varied problems in steel procurement discussed during the January 21 to 23 meetings of ASTM Committee A-1 on Steel in Houston, no native son of Texas seemed worried about the quality of steel in his peacemaker—at least no overtures were made in this direction. However representatives of the petroleum and petrochemical industries now situated in the Houston area swelled the attendance to record heights at committee meetings where tubular products were under consideration.

For the first time in a good number of years it was proposed to include a new steel-making process in an ASTM specification. Both Kaiser Steel Corp., and Jones & Laughlin Steel Corp. have requested that the oxygen converter process (known in Europe as the L D process) be included in Specifications A 120 for black and hot-dipped galvanized welded and seamless steel pipe. Kaiser Engineers holds the license for the process in this country. This steel has been accepted by Lloyds for shipbuilding and also is generally accepted in Europe and the Middle East for pipe manufacturers, pressure vessels, penstocks, etc.

A new rivet steel specification has been drafted, intended to cover alloy rivet steel suitable for use with high-strength low-alloy steel. The tensile strength range is 68,000 to 82,000 psi, with a yield point of 50,000 psi, minimum, and an elongation in 8 in. of 20 per cent minimum.

Specifications for special large size deformed billet-steel concrete-reinforcement bars (Nos. 14S and 18S) have been approved by the concrete-reinforcing-steel subcommittee. These large bars are beyond the scope of the present Specifications A 15 and A 305. Ready for subcommittee deliberation are specifications for hot-rolled plain rods in coils for concrete reinforcement and for uncoated seven-wire stress-relieved strand for concrete reinforcement. Specifications for hot-rolled deformed rods in coils are being developed. Those interested in wire reinforcement should note that changes are also in prospect for Specifications A 82 and A 185 in 1957.

The sheet and strip steel group is very active, with revisions of Specifications A 109, A 245, A 303, A 365, and A 366 under consideration. New specifications for commercial quality hot-rolled carbon steel sheets, carbon steel sheets of flange and firebox quality, enamelling iron sheets, and low-alloy high-tensile sheets of structural quality are being developed.

In the field of tubular products, a

new specification for centrifugally cast ferritic alloy steel pipe for high-temperature service is being drafted. Stainless steel received much attention in the Joint Subcommittee on Stainless Tubing Specifications of Committee A-1 and Committee A-10. Raising the maximum limit of phosphorus, addition of extra-low-carbon grades, a new specification for welded large outside diameter stainless pipe, and the addition of a modified type 430 to Specification A 268 were some of the items discussed. The nuclear power industry has indicated urgent need for specifications covering this grade of material.

Cast Iron

Research into the effect of elevated temperatures on the properties of cast iron is scheduled for completion in 1957, according to Subcommittee XXII of Committee A-3. This investigation is sponsored by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals and has been underway at the Southern Research Inst. for several years. The results of the investigation will undoubtedly affect the use of cast iron in high-temperature power facilities including nuclear reactors.

Metallography

Committee E-4 announced its intention to have the Society publish a proposed method for the Classification of Phases in Metallurgical Systems. This will be submitted to metallurgical groups throughout the world as a universal classification system.

The electron microscopy group's research has brought it to the final stages of recommended practices for sample preparation, etching, and replication. These advances will have a widespread impact on the use of the electron microscope in the metallurgical field.

Corrosion of Iron and Steel

A report at the Committee A-5 meeting of the 20-year inspection and collection at the nine wire and fencing test sites shows generally that the corrosion rate has been much less than was originally anticipated. For this reason the committee will continue these exposure tests until significant results are obtained. The data from this 20-year inspection and collection will be published as soon as possible.

The use and accuracy of magnetic thickness gages was discussed and an interlaboratory collaborative test of zinc coatings using these instruments was proposed. From this work a recommended practice for the use of hand-held magnetic thickness gages will be prepared. It is expected that this type of gage will eventually replace the Preece test.

Corrosion of Non Ferrous Metals

Committee B-3 plans a new and extensive atmospheric corrosion program on non-ferrous metals and alloys. The program calls for the exposure of many of the newer alloys and some of the metals such as titanium, which have recently gained commercial importance. The exposures will be made at Point Reyes, Calif., Kure Beach, N. C., State College, Pa., and Newark, N. J. These sites will provide a mild and severe marine exposure, a rural, and an industrial atmosphere exposure. Plans call for the removal of specimens at the end of 2, 7, and up to 20 years.

An eight-year program of calibrating various exposure sites in North America has been completed. The data will be published in the near future and will show the relative corrosivity of the various locations. Zinc and steel panels have been used in this project. Initial examination of the data reveals a rather wide range of corrosive conditions.

Work on the salt spray (B 117) and acetic acid-salt spray (B 287) is continuing, particularly in factors affecting reproducibility, changes in test requirements necessary to give test results equivalent to the former 20 per cent salt concentration, and the possibility of reducing the acidity of the acetic-acid salt solution.

Metallic Materials for Electrical Heating, Resistance, and Contacts

Control of a guided missile or a nuclear reactor may often hinge on the reliability of a microcontact designed to operate sensitive electronic circuits. The reliability of this important link in the instrumentation and control chain for numerous automated industrial and defense devices, is under intensive study in Committee B-4 which met in Philadelphia on March 8, 1957. A. L. Van Emden, Chairman of the Section on Microcontacts, reported results of interlaboratory tests to evaluate the effect on contact reliability of variations in contact force under controlled test conditions. Tests were run at a current of 500 μa and with contact forces in two ranges in steps from 1 to 1.5 g and 5 to 15 g. Objective of the continuing test program is to develop a method which will indicate the degree of reliability of contacts under specified conditions.

Contacts in use over a period of time will accumulate a film on the surface which increases contact resistance and limits contact life. In an effort to develop a satisfactory life test for contacts, the committee has evaluated films of oxide on the contact surface. Because oxide films have shown an uncontrollable variability, the committee is investigating the effect of sulfide films. Contact materials used in these investigations include silver, copper, and coin silver.

In order to simplify the practice in the industry of stocking and handling a large number of sizes and shapes of contacts, the committee is expected to recommend to the Society at the Annual Meeting for publication as tentative, a recommended practice for projection welding contact dimensions. Suggested dimensions for such contacts were published in the October 1956, BULLETIN. The next project toward simplifying industry practices on shapes and sizes will be concerned with rivet contacts.

High-Current Contacts

The field of interest in the committee on high-current contacts is in the range of 60,000 to 90,000 amp. Several experimental devices have been proposed for use in testing contacts in this range. One device which offers promise provides a means of closing and opening contacts at controlled speeds to control the amount of arcing. Preliminary tests have been run at about 100 amp, but it is believed that the findings on these tests can be applied to tests at higher currents. The experimental program of the high-current group was preceded by a rather thorough literature survey.

Static Connectors and Connections is the title of a newly organized section, C. E. McCarthy, Chairman. The group has agreed upon a test device for interlaboratory testing. Crossed wires of noble metals will be placed in contact and let stand under force of 200 g, with measurements of resistance after different periods of time.

A task group on sliding contacts, organized last year, has completed a literature search and will make available to its members appropriate papers on the subject prior to outlining a program of work.

Thermostat Metals

At the meeting, U. U. Savolainen demonstrated a device which will greatly increase the sensitivity of flexivity measurements on thermostat metals. Flexivity refers to the change in curvature of thermostat metal with change in temperature. This group is also concerned with measurements of thermal conductivity and emissivity of thermostat metals.

Die Cast Metals

Committee B-6 approved the deletion of two aluminum-base alloys and a zinc-base alloy from ASTM specifications covering die castings. They also recommended that a magnesium-base alloy be dropped. Aluminum-base alloys SC54A and SC54B are no longer used since they have been replaced by better alloys. Zinc-base alloy AC43A and magnesium alloy AM100B were dropped also since they are not as stable as other alloys.

Some of the most significant results of the meeting were final discussions concerning specification B 86 covering zinc-base die castings. Changes contemplated in the specification include raising the maximum copper limit in alloy AG40A from the present 0.15 to 0.25 per cent and the addition of a footnote stating that copper in the range of 0.25 to 0.75 per cent will not affect the serviceability of these die castings in the majority of commercial applications. In process is a note of warning stating that alloy AC41A should not be subjected to prolonged exposure to temperatures above 200 F.

Light Metals

Committee B-7 became a new member of the growing group of ASTM committees participating in international work by approving the functioning of its Advisory Subcommittee as the Advisory Group to the American Standards Assn. in the activities of ISO/TC79. ASA is the official American member body of the International Organization for Standardization (ISO).

Those using the ASTM specifications for manufacturing and purchasing aluminum and magnesium products should note that many revisions are in prospect for 1957. In addition specifications are being developed for high-strength aluminum bus bars, for aluminum cold heading wire and rod, and for anodic coatings on aluminum.

Electrodeposited Metallic Coatings

A preliminary outline of an atmospheric exposure program entailing 27 plating variations of panels at three test sites was reported by Committee B-8. The specimens cover copper, nickel, and chromium plating on various aluminum alloys and also include similar plated coatings on steel panels for comparison.

A Summary of Observations of Factors Influencing Adhesions of Organic Coatings to Chromium-Plated Surfaces was presented for Committee approval. The purpose of the report is to serve as a guide for those interested in the use of supplementary organic coatings on chromium plated surfaces. It will be published in the committee's 1957 Annual Report.

The highlight of the B-8 meeting was an illustrated paper on chromate films on electrodeposited zinc by Messrs. Nagley, Katz, and Proctor of the Bureau of Ships. Color slides showed the appearance of the panels coated with various chromate films on electrodeposited zinc as initially processed and after 3, 6, 9, and 12 months' exposure on a deck of ship, and in the hold.

Chemical Resistant Mortars

Silicate and resin mortars received the primary attention of Committee C-3 at its meeting in New York, February 19.

The committee approved a proposed method of test for compressive strength of chemically setting silicate mortars and a proposed method of test for flexural strength for chemically setting silicate mortars. It also approved a specification for resin mortars.

Three recommended practices for use as guides for storing, mixing, and using silicate mortars, resin mortars, and hydraulic mortars were adopted by the committee.

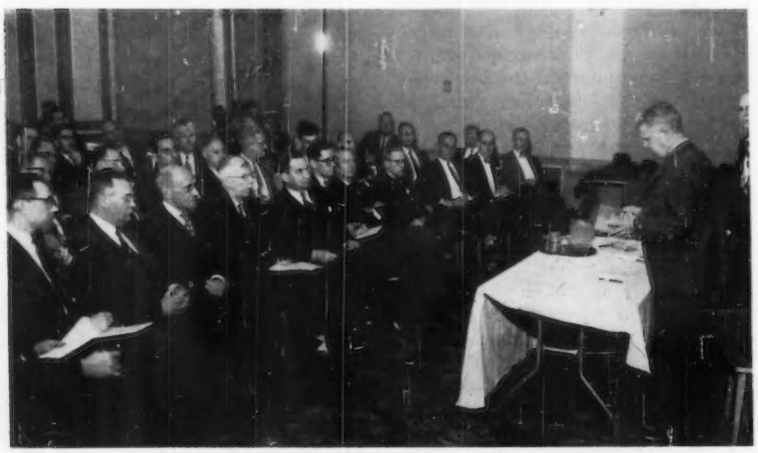
The present Method of Test for Bond Strength of Chemical-Resistant Mortars (C 321) was revised to include the use of wet brick and the conditioning of specimens.

The committee is continuing work in the development of absorption and porosity tests. Work is also continuing on the evaluation of thermal expansion and the determination of working life and setting time for silicate mortars.

Lime

A change in the minimum weight of vermiculite aggregate for use in interior plaster was approved by Committee C-7, revising the present limits in ASTM Specification C 35 from 7½ to 6 lb minimum. This confirmed previous action by Committee C-11 on Gypsum which has joint jurisdiction over this standard.

The Standard Specification for Hydrated Lime for Varnish Manufacture (C 47) was recommended for withdrawal as an ASTM standard since the very small tonnage of lime used for this purpose is not sufficient to justify



Administrative Committee on Nuclear Problems

This special committee was established by the Board of Directors to keep under its surveillance the needs and opportunities for ASTM technical committee work in the multiphased nuclear energy field. Pictured above is the meeting of the committee held during Committee Week in Philadelphia to discuss with the officers of the 75 ASTM technical committees or their representatives nuclear work that can be accomplished within the Society's committee structure. Presiding at the meeting was Past-President Norman L. Mochel, chairman of the Administrative Committee.

the need for a standard specification. A revision of the Specification for Quicklime and Hydrated Lime for Silica Brick Manufacture (C 49) was approved with the addition of a method of test. Revisions of the Standard Methods of Sampling, Inspection, Packing and Marking of Quicklime and Lime Products (C 50) and the Standard Methods of Physical Testing of Quicklime and Hydrated Lime (C 110) in the nature of refinement in procedure were approved for letter ballot.

Refractory Materials

REFLECTING the necessity for standards for new refractory products developed in recent years, a tentative classification was approved by Committee C-8 for castables or refractory concretes. Approval was given to a tentative revision of Standard Fireclay Brick Classification (C 27-41) lowering the P.C.E. (Pyrometric Cone Equivalent) requirements of the Low-Duty class from cone 19 to cone 15. This will permit inclusion of certain steel pouring pit refractories and prepare the way for an eventual standard specification for these materials.

A proposed classification for silica brick resulting from some extensive cooperative testing is to be circulated for comment to the manufacturers of this product. The classification is based chiefly on chemical requirements. The National Bureau of Standards has advised the Committee that two new standard samples of silica brick with alumina contents in the range of interest in the classification are ready for round-robin testing. A group of ten commercial laboratories have signified their willingness to join in this project.

It was reported that a cooperative study with the National Bureau of Standards of various types of furnaces for determining the P.C.E. values of refractories is well under way. This study may lead to the selection of a single standard furnace and more precision in the determination of P.C.E. values.

A suggested classification for mullite brick is to be delayed until a number of special standard tests can be developed to define the requirements more carefully. A study of a hot load (compressive) test for this purpose was authorized as the first step in this program.

The committee reports that the editorial work for the 1957 edition of the "Manual of ASTM Standards on Refractory Materials" is practically complete and the publication should be available for distribution this summer. In addition to new standards or revisions made since the 1952 edition, new industrial surveys on heat-treating furnaces will be included.

Gypsum

The making and testing of compression test specimens of gypsum plaster taken from the board or nozzle of a plaster application machine has been under consideration in Committee C-11 for some time. A draft of a proposed method was reviewed and a number of changes suggested. With the acceptance of these changes a letter ballot of the subcommittee will be conducted with later presentation to the main committee for final ballot. Proposed changes in the Specification for Gypsum Plaster (C 28) were accepted including a revision of the scope to include gypsum bond plaster and changes in other sections of the specification to cover the requirements for this type of plaster.

A proposed specification for paper used in gypsum board products is awaiting further evaluation tests to determine flame spread. A number of test requirements are under consideration for inclusion in a proposed specification for joint tape and cement. Other developments include a method of test to evaluate mold resistance treatment of face paper on gypsum formboard and a definition of type "X" gypsum wallboard.

Masonry Mortar

Aggregates for masonry grout will be covered in new specifications accepted by Committee C-12. The proposed specification will include both natural and manufactured sand used alone, or in combination with coarse aggregate, in grout for reinforced masonry. Subject to a favorable letter ballot of the committee, these specifications will be presented to the Society for acceptance at the Annual Meeting in June.

The present Specification for Mortar for Unit Masonry (C 270) is to be revised to avoid misuses which have been observed. Field tests of mortar are being conducted and the resulting test data referred to in the requirements of Specification C 270. This is not the intent of the specification. The revision will clarify this to prevent such misuse.

Thermal Insulating Materials

THE measurement of abrasion resistance of thermal insulating materials is included in a new proposed method of test submitted to Committee C-16. A recommended practice for prefabrication or field fabrication of thermal insulation fitting covers was also accepted by the committee subject to confirming letter ballot. A third new tentative presented was a proposed method of preparing specimens of bituminous and nonbituminous coatings for testing purposes.

Many projects were reported in progress in the various subcommittees. Among them are a specification for insulating roof deck slab; a corrosion test for insulating cements; a method of test for density for loose fill insulation; changes in a proposed hot surface performance test; definitions of terms relating to reflective insulation; and a thermal conductivity method to cover higher temperature ranges up to that of refractory materials.

Porcelain Enamel

Committee C-22 is circulating a proposed method of test for torsion resistance of laboratory specimens of porcelain enameled iron and steel for committee action. Five other projects on physical properties include spontaneous spalling, tearing, evaluation of enameling iron, coefficient of expansion, consistency of enameling slip.

The committee is also gathering data for evaluation of the effect of enameling iron and ceramic coatings on low- and high-alloy metals at elevated temperatures, fishscaling, evaluation of enameling iron, engineering parameters for porcelain enamel, resistance of porcelain enamels to steam condensates, and a study of available and required tests for dry process cast iron porcelain enamels.

Road and Paving Materials

Among the many important subjects under study by Committee D-4 are mechanical stability tests for designing bituminous mixtures, development of tests for the setting properties of bituminous materials, accelerated durability tests for bitumen, and the factors involved in the effects of water on bituminous coated aggregates. The committee is also reviewing some of its time-honored tests to evaluate how effective they are. Statistical methods

are being used to analyze the cooperative test data.

In cooperative tests on the softening point method (D 36) by eight laboratories, the single thermometer appeared to be more satisfactory than the double thermometer method. An investigation of extraction of constituent bituminous mixtures by centrifuge is being conducted and a quick test method for field use is being considered. Good reproducibility has been obtained in cooperative tests on a rolling ball test procedure for determining setting qualities of liquid bituminous materials. A new method on stone coating and stripping is under study in the subcommittee on emulsion tests. The thin film oven test will be published as an appendix to the Annual Report to the committee. Cooperative tests to establish the reproducibility of the method using the sliding plate viscosimeter are being conducted. A new non-toxic solvent is being given preliminary testing to establish its qualification, with samples of various asphalts to be furnished by the Asphalt Institute. An approved needle for use in the penetration test (D 5) has been distributed to subcommittee members for study and use.

Coal and Coke

Committee D-5 on Coal and Coke reviewed progress in its many research programs in the field of coal. These programs include the study of the Gieseler plasticity tester and an electrical method for measuring free swelling index. Analytical studies include determination of volatile matter and mineral carbon dioxide in coal, and the determination of ash softening temperature in both reducing and oxidizing atmospheres. Six laboratories reported data on the coal sampling program based on the new statistical approach. The results thus far have been very encouraging.

In addition, plans were made for work leading to specifications for three new analytical determinations: chlorine in coal, forms of sulfur in coal, and sulfur trioxide in coal ash.

Paper and Paper Products

A great deal of research on paper is being carried out throughout the pulp-producing areas of the world. Not only are new uses being developed for paper, but also new methods of testing paper. For this reason, Committee D-6, which met in February in New York City, wishes to gather as many of these new paper testing developments as possible for a symposium to be given at the 1958 Annual Meeting.

Almost every state in the Union has its own paper flammability test. Some states have very severe specifications for nonflammability In order to improve the usefulness the of the ASTM Method of Test for Flammability (D 777) and work toward a more uniform test, all state and paper manufacturer methods are being collected for review.

Wood

Among the more interesting of the projects reported to Committee D-7 was an accelerated laboratory test method for the evaluation of natural decay resistance of wood which is being considered together with a method for measuring the effectiveness of wood preservatives. The committee also accepted revisions in the basic methods for Establishing Structural Grades of Lumber (D 245). These revisions cover the stress grading of lumber for strength.

The committee is also considering major revisions in Standard Method of Test for Integrity of Glue Joints in Laminated Wood Products for Exterior Service (D 1101) as a result of data accumulated by the Forest Products Laboratory and the Department of the Navy. A new method for hardness penetration determination is being submitted to subcommittee letter ballot for inclusion in Tentative Specification for Modified Wood (D 1324). Both electric and nonelectric methods for the measurement of moisture content for treated wood are being developed.

Standard Definitions of Terms Relating to Fiberboards have been accepted and, subject to letter ballot, will be referred to the Society in June.

Bituminous Waterproofing and Roofing

While no new standards were adopted by Committee D-8 its subcommittees reported many projects in various stages of completion.

A specification for glass fabrics for use in waterproofing and in the construction of built-up roofs is expected to be ready for presentation to the committee for acceptance at the Annual Meeting in June. A series of test methods on surfacing materials for built-up roofs is being studied. Specifications for brushable and trowelable cutback asphalt roofing materials also are under consideration.

A study of accelerated tests of roofing materials is under way with the expectation that three separate procedures known as panel preparation, end point test, and weathering procedure will be established.

Electrical Insulating Materials

A recurring problem in the evaluation of engineering materials is in interpreting data obtained from ASTM tests in terms of how the materials might perform in service. When results of a particular test are found to correlate with performance, the significance of the test is enhanced and within the limitations of the correlation found, performance in service may be predicted. Since 1944, Committee D-9 has had in progress an extensive cooperative testing program with the objective of distinguishing among the many available brands of insulating oil with respect to oxidation resistance and chemical breakdown during service. At a symposium session held in conjunction with meetings of the committee in Roanoke, Va., in February, T. A. McConnell of the Detroit Edison Co. reported the results of this long-term test program. The report indicated that results of three tests—interfacial tension, neutralization number, and color—when taken in combination are fairly reliable in predicting the amount of sludge that might be found in a transformer after a period of service. These three tests were also found useful both for new oil and oil in service. Tests for sludge accumulation and pressure oxidation were found satisfactory for evaluating new oil but not for oil in service.

In the laboratory evaluation of the tendency of insulating oils to sludge, copper in one form or another is used as a catalyst to accelerate sludging. In the United States a solid copper catalyst is preferred, while in many European laboratories there is a preference for a soluble copper catalyst. E. L. Raab of the General Electric Co. presented a comprehensive report of round-robin sludge tests comparing the solid and the soluble catalysts. Results which have been analyzed statistically are subject to some differences in interpretation and while some evidence was presented for concluding the superiority of the solid catalyst, there is something to be said for an opposite conclusion based on a different interpretation of the data. The problem of analyzing sludge-test data is currently being considered by a task group of Committee E-11 on Quality Control of Materials.

The committee is cooperating actively with the American Group of Technical Committee 15 on Electrical Insulating Materials of the International Electrotechnical Commission. In order to establish the American viewpoint on a number of methods which have been proposed to the IEC,

subcommittees are planning interlaboratory test programs to evaluate the methods. Data from these interlaboratory tests will be presented at a future meeting of the IEC in order to back up the American viewpoint.

Rubber

Among the more important accomplishments of Committee D-11 was the presentation of revised methods for testing rubber hose (Tentative Methods of Testing Rubber Hose D 380); revised specification for three kinds of insulating tape (Friction Tape of General Use for Electrical Purposes D 69; Rubber Insulating Tape D 119; Ozone-Resistant Rubber Insulating Tape D 1373); a new method for sampling synthetic rubber; and a revision of methods for determining the viscosity of rubber (Tentative Method of Test for Viscosity of Rubber and Rubber-Like Materials by the Shearing Disk Viscometer D 927).

In all, the subcommittees proposed 10 revised methods, 3 revised specifications and 2 new standards including one for sampling synthetic rubber and one for testing of tapered specimens for resistance to cracking. In addition, the subcommittees reviewed 20 current projects and appointed 12 study groups and task forces to extend the research of the committee. Some of the more important studies will investigate the equivalent cure between slabs for tension tests and slabs for compression set determinations or other products of irregular contour; tests for rubber chemicals other than accelerators and antioxidants; and dynamic flexing methods for use in ozone testing.

Industrial Water

Committee D-19, at its January meeting, in Charleston, S. C., approved four proposed new tentatives for committee letter ballot, covering methods of test for nitrite by the Rider-Mellon method, for low concentrations of iron by the phenanthroline method, or for appearance properties of industrial water and for sampling homogeneous industrial waste water.

Some 20 new and revised methods of testing industrial water and industrial waste water are currently under development. Among the more significant new projects are those on flow measurement, determination of hydrogen, measurement of radioactivity, measurement of surface tension, determination of surface-active materials, determination of biochemical oxygen demand, and performance tests on ion-exchange resins for water treatment.

A symposium on determination of dissolved oxygen will be sponsored by Committee D-19 at the 1957 Annual Meeting of the Society. Preliminary plans were initiated for a symposium on examination of industrial water and industrial waste water for radioactivity, preferably to be arranged for the 1958 Annual Meeting.

Plastics

Departing from the usual pattern of subjects considered at ASTM meetings, Committee D-20 on Plastics at its Research Session held in Roanoke, Va., on February 28, included in its program a round-table discussion on the development of working stresses for plastics. A. G. H. Dietz, Chairman of the Research Subcommittee, pointed out that with the increasing application of plastics to structural uses it is necessary to establish working stresses for design of safe and durable structures. Much can be learned from past and present practices with structural steel, concrete, and wood in the design of structures. As more is learned about the properties and variability of the material in question, the more precisely one can establish the factor of safety. Formerly, working stresses for structural steel were set at about 16,000 psi. Now working stresses of 20,000 psi are commonly used, as compared with the ultimate strength of about 70,000 psi.

Members of the round-table panel were F. W. Reinhart, H. A. Perry, Jr., R. H. Carey, and H. W. Kuhlman. Mr. Reinhart pointed out that when plastics are evaluated by ASTM tests it is often difficult to interpret the values obtained. What is needed is a statistical measure of the reliability of the measurements. A frequent fault is to consider a specification value as an engineering value upon which to base design. The engineering value at the present time can only be determined by experience and an educated guess. Specification values are only intended to identify the material and to set a level of quality, not to indicate use. Mr. Perry agreed that statistical measures of reliability are needed and that one could not take chances in designing structures. He suggested the establishment of working stresses on basis of multiples of the standard deviation from a number of test determinations.

Mr. Kuhlman who has been working for some time on the development of working stresses for plastic pipe, indicated that in designing for plastics one must take into consideration the time factor under load in a given environment. He suggested that a plot of stress versus time indicating the failing stress at 1000 hr might be a suitable base line for establishing working stresses. He suggested that working stresses for pipe be based on a four-to-one safety factor on a criterion of 1000 hr failing-stress value. Mr. Carey pointed out that in addition to the factors mentioned by the other panel members, one should also consider very carefully the effects of various environments in establishing factors of safety. Professor Dietz summed up the discussion and added that it is often necessary to design on a basis of maximum deflection under design loads rather than on a basis of some fraction of the ultimate strength. He emphasized the importance of keeping stress levels low enough to avoid undue distortion of the material.

The Research Session also featured the presentation of three papers, as follows:

Use of Time-Temperature Curves in Characterizing Polyethylene—Julius L. Silver, Bakelite Co.

Ultrasonic Propagation in Glass Fiber Reinforced Plastics—A. G. H. Dietz, Massachusetts Institute of Technology

Measurements of the Elastic Modulus of Films—J. K. Owens and G. W. Strain, E. I. du Pont de Nemours & Co.

Recommend Seven New Tentatives

As concrete evidence of the rapid growth of the plastics industry and the hard work of the committee, three new specifications, three new methods of test, and a recommended practice have been completed for recommendation as tentative. The recommended practice is for fluorescent light and fog chamber exposure of plastics which will supplement the widely used S-1 Sunlamp Exposure test (D 795) in use for some time. New test methods are for density, transverse loading of corrugated panels, and orientation stress for plastic sheeting. Specifications cover extruded cellulose acetate butyrate pipe, nonrigid plastic film and thermoplastic sheet, and biaxially oriented polystyrene sheeting. The committee will also recommend revisions in seven methods under its jurisdiction. The well known heat-distortion test (D 648) may get a new name. It was

pointed out that it is common to misinterpret the meaning of this test and it was felt that a more explicit title would tend to discourage this misinterpretation. The new title on which the committee will ballot for approval is Method for Determining Flexural Deformation Temperature of Plastics Under a Standard Load.

Radiation Effects on Plastics

Wide variations in the effects of nuclear and high-energy radiation on the properties of organic materials, and particularly on polymers, have been observed and noted in the literature. Researchers are increasingly expanding the knowledge of the mechanism of these effects, which involves the splitting apart of large molecules with the formation of free radicals and the recombining of these free radicals in various ways. Some properties of organic materials are improved by radiation, others are damaged, with some materials showing general improvement initially and others immediate and serious degradation.

There is widespread interest in establishing standards for measuring these effects and reporting data in the literature in a consistent manner so that results obtained by different investigators may be compared. This widespread interest was evidenced by the excellent attendance at the meetings of the Joint Subcommittee on Radiation Effects on Plastics and Electrical Insulation of Committees D-9 and D-20, which met in February in Roanoke, Va. Much of the discussion at the meeting was in attempting to decide which of the many facets of the radiation effects problems should be tackled first. Some agreement was reached on certain aspects of the approach. For example, it was agreed that at least for the present, radiation dosage would be expressed in the units ergs per gram rather than rads, reps, or other units which currently appear in the literature. It was also agreed that the types of radiation which should be considered would include electrons or beta rays, gamma rays, neutrons, and finally mixed radiations. Of the many instruments for measuring dosage which are available, the group decided to concentrate its efforts on five types of dosimeter. Preference was expressed for dosimeters based on chemical change and on ionization.

One matter of immediate interest is to determine the correlation among the different sources of radiation so that data reported for one type of radiation such as electrons, might be related to data reported for, say, gamma rays or neutrons. The group concerned with defining this problem had difficulty arriving at an understanding of the program of work. The same can be said for the groups concerned with total dosage and dose rate effects, and on postirradiation effects. The question of how to define the problems in this field and how to organize a program of work was considered in some detail at a meeting called by D. S. Ballantine, Chairman of the group, with chairmen of the various sections. It was evident from the discussions of this group that before the subcommittee can get down to a definite work program it will be necessary for a small group to outline the short and long range objectives in this field, to define the problems, and to establish the order in which effort should be applied. Chairman Ballantine pointed out that radiation effects standards cannot be expected in the near future. Initial work of the subcommittee will be to build up a volume of data upon which recommended practices and test methods can be based.

Atmospheric Sampling and Analysis

While spot checks on concentration of air pollutants provide useful information, recording instruments have the advantage of recording more data, especially on cyclic variations. Also, they can operate unattended for long periods, relieving technical personnel for other duties. For these reasons, Committee D-22 at its meeting concentrated much of its effort on development of methods for continuous recording of air pollutants. The committee approved an alternate method for continuous recording of sulfur dioxide known as the electrolysis method to be added to the conductivity method already published as tentative (ASTM Method D 1355). This will be submitted to the Society for adoption at the Annual Meeting in June. A method for continuous recording of fluorides in the atmosphere is under intensive study and progress toward developing a tentative method was reported.

Adding to its previously published recommended practice for planning the sampling of the atmosphere (D 1357), the committee is preparing specific sampling methods employing dust fall jar, impingers, and directional dust fall collectors. The latter device will be especially useful in locating sources of pollution.

Cellulose

A particularly significant decision was reached at the February meeting of the Executive Subcommittee of Committee D-23. Through the courtesy of The Buckeye Cellulose Corp., plans were made whereby seven bales of pulp and cotton linters are to be collected for storage and distribution of aliquots on request. For the first time, carefully prepared uniform samples of seven pulps representing the entire spectrum of commercial purified celluloses will be available from one central location to various committees evaluating cellulose methods. These standard samples will be made available not only for interlaboratory testing of methods in the United States, but also to the International Committee for Cellulose Analyses. The seven samples are:

Cotton linters, acetate grade (Buckeye Type 1AR500)
Acetate grade sulfite pulp (Rayonier's Rayaceta)
Prehydrolyzed sulfate tire cord pulp (Buckeye Type V-5)
Rayon grade sulfite (Riordan's Novocell)
Cellophane grade sulfite (Rayonier's Rayamo)
Paper pulp, regular grade (Swedish pulp)
Paper pulp, grease proof grade (Swedish pulp)

Initial interlaboratory testing is to be concerned with the nondilution alkali solubility procedure for pulps. The assistance of Subcommittee VI on Statistics is to be obtained in planning the program for the interlaboratory testing of these procedures. The plan calls for comparison of available Swedish, Canadian, and German methods.

It is believed that the availability of these standard samples will then expedite parallel methods evaluations for ash, pentosans, lignin, disperse viscosity, absorption, and color, chromatographic analyses of noncellulosic impurities, and functional groups such as carboxyl groups and carbonyl groups.

Copies of a more detailed report of the discussions at this meeting may be obtained from Committee Secretary W. W. Becker, Hercules Research Center, Wilmington, Del.

Carbon Black

Blacker inks and white-wall tires that stay white may result from the activities of the new ASTM Committee D-24. The committee reports that producer-consumer agreement has been reached on a number of methods for evaluating the properties of carbon blacks. Approved for recommendation for publication as tentative were four methods for determining physical properties, including attrition, pellet-size distribution, pour density, and sieve residue. Other methods under active consideration are for determina-

tion of fines, ash content, weight loss on heating, pH, and iodine value. The committee is also developing a test for discoloration of benzene by carbon black. This test is designed to indicate the tendency of some rubber-reinforcing carbon blacks to cause discoloration of other materials, for example, white-wall tires, by migration of stain-producing agents.

Committee D-24 was organized in 1956 for the promotion of knowledge of the properties of those materials generally known as carbon blacks, including stimulation of research and the development of methods of test, classification, specifications and nomenclature. These activities will be coordinated with those of other relevant committees of ASTM.

Casein and Similar Protein Materials

At this first meeting of Committee D-25 possible definitions of terms were considered. Methods of test for sampling were discussed and methods for testing the viscosity of the casein were approved. The chemical testing of casein was reviewed, and tests for moisture, nitrogen, fixed ash, fat acidity, pH, and total acidity were considered. In the area of physical testing, a particle size method will be processed by the committee.

An interlaboratory collaborative test program has been set by using samples of casein and soy protein. These samples will be tested for moisture, particle size, viscosity, and solubility using methods discussed at the meeting.

Methods of Testing

Numerous projects and reports were reviewed by Committee E-1 and action taken on a number of matters which will be submitted to the Society for adoption at its Annual Meeting in June. Among the more important are revisions in Tentative Method of Verification of Testing Machines (E 4) to provide new information on the selection of test loads and to clarify the basis of verification of the testing machine. A revision in Tentative Methods of Verification and Classification of Extensometers (E 3) will include a new classification of extensometers for determining the yield strength of metallic materials. Several new definitions on fatigue testing will be added to the Tentative Definition of Terms Relating to Methods of Mechanical Testing (E 6) which will make them practically identical with those now published in the ASTM Manual on Fatigue Test. Also included in E-6 will be a series of definitions relating to creep testing.

The committee will submit to the Society for adoption in June a revision of the Methods of Test for Thickness of Solid Electrical Insulation (D 374)

Proposed Tentative Specifications for Gravity-Convection and Forced-Ventilation Laboratory Ovens were completed by the Task Group on Laboratory Ovens and will be recommended for publication as tentative. These specifications cover the performance requirements for general-purpose air-ovens ordinarily used in testing operations.

Testing Building Constructions

Adoption of four new projects and a complete reorganization of its subcommittee structure featured a well-attended meeting of Committee E-6. Representatives of a number of building code organizations stressed the importance of the work upon which the committee is now engaged in the further development of modern building codes, since these documents trend more and more in the direction of performance codes, for which standard test methods as well as specifications are essential.

Work already done in testing methods for trusses (E 73) will be extended into the field of testing wooden roof trusses, which are now being widely used in house construction. Standard methods of test for vapor barriers under concrete slabs on the ground, used for house foundations, were slated for development after consultation with Committee C-16 on Thermal Insulating Materials. A new group will study a proposed method for making load tests on completed structures, standardization of which is urgently needed in building codes.

The difficult problem of testing windows will be tackled by a new subcommittee, there being unanimous agreement that standard methods of test for these vital building components are urgently needed. The committee is planning a symposium on durability for the 1958 Annual Meeting in Boston.

Absorption Spectroscopy

Definitions and symbols relating to absorption spectroscopy were approved at the March 4 meeting of Committee E-13 in Pittsburgh for submittal to the Society for publication as tentative. This first proposed tentative prepared by the committee is expected to do much to promote uniform nomenclature in this field.

A new group of IBM index cards, covering spectra in the visible range, was approved for distribution by the Society. A system for indexing spectra in the near infrared range will be studied, preparatory to providing IBM index card coverage of absorption spectra in this range (approximately 0.8 to 3μ). It was reported that the currently available decks have grown to 12,766 infrared index cards, 7066 ultraviolet index cards, and 13,899 empirical formula-name cards covering infrared spectra.

Proposed methods for the evaluation of apparatus for absorption spectroscopy were reviewed. The purpose of these methods is to make it possible to specify the essential performance requirements for the apparatus in specific methods for analysis by absorption spectroscopy, by providing means for measurement of the specified characteristics.

Proposed general methods for analysis by infrared spectroscopy and by ultraviolet spectroscopy were considered. These general methods are intended to cover the various analytical techniques and methods of calculation of results so that references to the general methods may be incorporated in specific methods for analysis in lieu of repetition of details of procedure or calculation common to several methods.

The committee also considered a proposed format for absorption spectroscopy methods that is intended to supplement more general ASTM recommendations on form of methods.

Materials for Electron Tubes and Semiconductor Devices

In the preparation of specifications for electron-tube cathode materials, an important consideration is the establishment of levels of certain trace elements so that the cathodes will have satisfactory emissive properties and will not develop excessive interface impedance. At its meeting in Washington, D. C., on February 1, Committee F-1 reported progress in improving the method of test for interface impedance. The data from extensive interlaboratory tests have been recorded on punched cards and will be analyzed at the Bell Telephone Laboratories. The committee is concentrating its efforts in measuring time constants below 1 microsecond

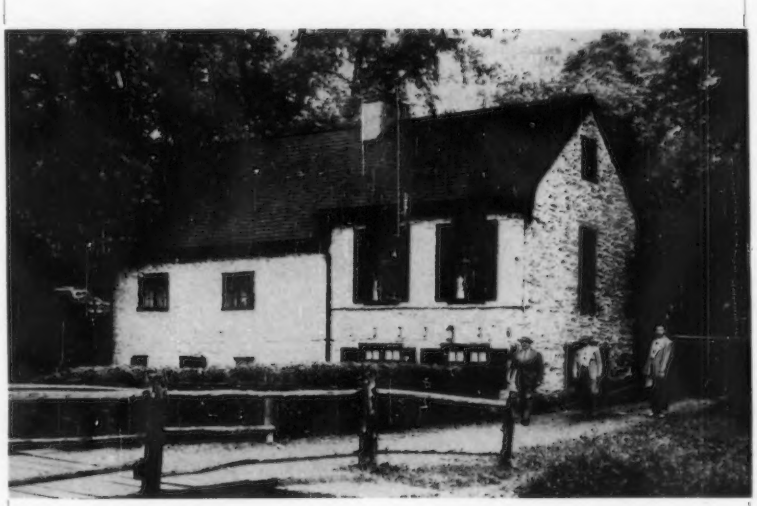
as it is this range which is most critical in measurement of low values of interface impedance. Tubes that develop an appreciable interface impedance lose their ability to handle high frequencies, especially pulses, and thus may be rendered inoperative in such applications as computers.

Long experience has indicated that measurement of physical, electrical, and chemical properties of materials outside an electron tube does not always indicate performance of the materials in a tube. Therefore, the committee is developing reference tubes, both diodes and triodes, in which the quality of materials and details of construction are carefully specified. These reference devices are useful for evaluating properties of tube materials. Such a device—a cylindrical diode—has been in use for some time for evaluating emissive properties of cathode materials (F 275). The committee is currently developing a planar diode and a planar and a cylindrical triode for evaluating tube materials. It should be pointed out that these devices provide information supplementary to that obtained by measurements on the materials themselves.

Highlight of the Washington meeting was an address by J. O. McNally, assistant director of electron tube development, Bell Telephone Laboratories, entitled "An Electron Tube for a Repeatered Submarine Telephone Cable System." Mr. McNally described the investigations leading to the construction of the trans-Atlantic telephone cable recently completed. Special features of this cable are the booster amplifiers spaced at intervals along the cable. Electron tubes in these amplifiers were designed to operate for 20 years without a tube failure. This corresponds to 6000 tube years of life, an extremely high degree of reliability.

INDUSTRIAL FIRSTS IN THE USA

The Rittenhouse Paper Mill



NEAR this house, which dates from 1707, and was the home of David Rittenhouse, first American astronomer and ardent patriot, was the site of the first paper mill in this country built by David Rittenhouse's great-grandfather in 1690. Willem Rÿttinghuisen, who orginally came from Westphalia, pursued his trade of papermaking as an adopted citizen of Amsterdam. He emigrated to Pennsylvania and settled on the banks of the Wissahickon, the beautiful stream whose extraordinarily scenic ravine is now a part of Philadelphia's Fairmount Park.

One of Willem's partners in the enterprise was William Bradford, the "American Caxton," a pioneer printer in the Colonies. Willem, his sons, and partners, built the mill with their hands, even without barrows since the only connections with the world were the bridle paths to German Town. The undershot wheel they hewed was connected by wooden cogwheel work to wooden tripham-mers that beat up the pulp in stone or iron mortars and smoothed the sized papers. Their raw material, the waste products of the German Town weavers, was brought into the glen on men's backs.

The paper molds, probably about 20 by 30 in., were made of fine screens of reed. Sewn inside were wires bent in the form of the watermark, a graceful linking of the W and R, the founder's initials. These molds were dipped into a vat of beaten pulp which, by a rapid motion of the hands, was spread over the inside surface of the mold. The pulp water ran through the screen, and the pulp took the shape of a very wet sheet of paper. When sufficiently dry, the sheet was turned onto a kind of blotter. In all, the process took about 2½ days.

In 1702 a flood washed the structure and machinery away and William Penn contributed 25£ toward reconstruction of a larger mill that supplied most of the paper used in the Middle Colonies.

Lightweight Corrosion-Resistant Pipe Standards Make Progress

BY J. D. MATTIMORE[1]

SHORTLY after World War II ended it seemed apparent that the use of austenitic stainless steel for piping, particularly in the chemical process industries, was likely to enjoy a phenomenal growth. Nevertheless, for several years, the rate of growth expected was retarded by the fact that the types of stainless steel desired were not available in the form of pipe lighter than that long designated "Standard Wall." Because austenitic stainless steel costs many times as much as carbon steel, it was essential to use as light walls as would sustain the internal pressure and the other normal structural loads to which pipe is subjected. Many users, therefore, employed the expedient of using stainless steel tubing, which could be obtained in a wide variety of diameters and thicknesses. The difficulty was that such tubing was not available in sizes suitable for mating with existing fittings, flanges, and valves. Because of the great number of possible diameters and thicknesses, there were no regularly manufactured fittings suitable for fusion welding (especially by butt-welding) to the available tubes. Another complication grew out of the facts that in corrosion-resistant service, for which the stainless steels were primarily required, it was generally undesirable to silver-braze the pipe joints; and the thin walls, dictated by reasons of economy (as well as other considerations), obviated the use of threaded joints. Furthermore, such tubes were not wholly satisfactory for use with regularly available pipe-supporting devices and with stock forms of molded insulation.

All of the factors mentioned contributed to making the procurement and assembly of a lightweight stainless steel piping system difficult, time-consuming and, in the last analysis, considerably more expensive than would have been the case if lightweight stainless steel pipe and its associated components, such as fittings, had been standardized.

The Mechanical Contractors Assn. (then known as the Heating, Piping and Air Conditioning Contractors National Assn.) which, as an industry, had been among the first to feel the need for such standardization, took the initial step to that end late in 1946. As a result of their activity, the dimensions of a new lightweight schedule of stainless steel pipe, known as Schedule 10S, was published in 1948 as an appendix to ASTM Tentative Specifications for Seamless and Welded Austenitic Stainless Steel Pipe A 312 – 48 T. In the following year American Standard B36.19 for Stainless Steel Pipe was approved by the American Standards Assn., covering not only Schedule 10S but also Schedules 40S and 80S in sizes ½ to 12 in. inclusive. The new schedule, 10S, had approximately one half the wall thickness of Schedule 40S, which corresponded to thicknesses formerly designated as Standard Wall, while Schedule 80S corresponded to the thickness otherwise designated as Extra Strong.

However, it soon became obvious that an even lighter weight of stainless steel pipe for chemical process services was economically desirable and, as a result of the advances that had been made in the art of fusion welding, it had been found practical, as well. Representatives of the chemical industry, the stainless steel pipe manufacturers, and the pipe fitting manufacturers met and jointly agreed upon a schedule of thicknesses, now designated as Schedule 5S, for sizes ranging from ½ to 12 in., inclusive. The thicknesses of the new schedule averaged three-fourths of the previously developed Schedule 10S over the full size range, with the more popular sizes being one half to two thirds as great as those of the heavier schedule. The new schedule of thicknesses was published as an appendix to Specifications A 312.

There can be no question concerning the value of the development of these two lightweight stainless steel pipe schedules to consumers, to piping contractors, and to manufacturers of pipe and especially of fittings. The result has been that these weights of stainless steel pipe and fittings are regularly stocked in at least three grades, namely, type 304, type 347, and type 316, in many places throughout the country. (Recently a trend has developed toward supplanting types 304 and 347 with type 304L, and type 316 with type 316L; this trend may ultimately reduce the types carried in stock to two.) Not only are the pipe and fittings readily available but the over-all cost of assembling stainless steel piping systems has been reduced by eliminating special fittings and adapters and obviating procurement delays.

The obvious advantages of the new standards of lightweight stainless steel pipe caused the American Standards Association's Chemical Industry Advisory Board, which had come into existence in 1950, to become interested almost immediately in promoting the use of the same schedules of thickness for other corrosion-resistant piping, such as aluminum, nickel, and copper and such of their alloys as find a use in the chemical process industries. Early in 1952, in conjunction with ASA's Mechanical Standards Board, the Chemical Industry Advisory Board requested ASTM to add the new schedules of pipe thickness to appropriate existing standards such as ASTM Specifications for Seamless Copper Pipe, Standard Sizes (B 42) and for Aluminum-Alloy Pipe and Tube for Pressure Vessel Applications (B 274); it further requested that where no specification existed, as in the case of silicon bronze pipe, for example, they be developed.

As a result of this request, dimensions of Schedules 5S and 10S pipe were added to Specification A 274 in the 1955 edition. The next editions of ASTM Specifications for Nickel Pipe and Tubing (B 161), Nickel-Copper Alloy Pipe and Tubing (B 165), and Nickel-Chromium-Iron Alloy Pipe and Tubing (B 167) will likewise show these dimensions. In actual fact, all of these materials, including some others such as the nickel-molybdenum and nickel-molybdenum-chromium alloys (more readily recognized as Hastelloy B and Hastelloy C, respectively), have been commercially available in the form of Schedule 5S and 10S for some time, prior to the development of applicable ASTM specifications, since both the aluminum and nickel-alloy pipe and tubing producers very quickly recognized the advantages to be gained thereby.

As matters stand presently, the only group of corrosion-resistant piping materials not available as Schedule 5S and 10S pipe is the copper and copper-base alloy group. For a great many years, copper pipe has, of course, been available in two thicknesses, regular and extra strong. The thicknesses of these are a few thousandths of an inch greater than standard wall and

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[1] Chairman, Subcommittee on Corrosion Resistant Pipe and Fittings, ASA Chemical Industry Advisory Board, and chief engineer, Product Engineering and Research Department, Tube Turns, Louisville, Ky.

extra strong steel pipe, respectively. Additionally, copper tubing, chiefly for heat-exchanger service, has been readily obtainable in many diameters and thicknesses. Copper water tubes in three weights designated types K, L, and M, the first being the heaviest, have also long been available. Such tubes do not meet the requirements of the chemical process industry because their outside diameters do not correspond to nominal pipe size diameters and therefore involve many of the problems mentioned in connection with stainless steel tubing. Additionally, in sizes above 5 in., their wall thicknesses are heavier than need be. This is likewise the difficulty with the product covered by ASTM Specifications for Threadless Copper Pipe B 302 – 55 T. In the small sizes this pipe is identical with Schedule 5S pipe dimensions but beginning with the $3\frac{1}{2}$-in. size its wall thicknesses are increasingly greater than those of Schedule 5S to the point where they are considered uneconomical by the chemical industry. This is evidenced by the fact that a survey conducted by the ASA Chemical Industry Advisory Board among chemical companies and chemical process designers and fabricators showed that a considerable majority of those replying to the questionnaire were in favor of having copper and certain copper alloys (notably silicon bronze, copper-nickel and aluminum bronze, all of which are highly useful as corrosion-resistant materials) made available with Schedules 5S and 10S dimensions of diameter and thickness.

For quite some time the matter of providing the desired copper and copper-alloy lightweight pipe schedules has been under consideration by Subcommittee W-4 of ASTM Committee B-5 on copper and copper alloys. In view of the many sizes and thicknesses of copper pipe and tube already available (the availability of copper alloys of the types mentioned above is markedly less), there is a natural reluctance on the part of the copper industry to add other lines. To them, such a step seems in opposition to the simplification which standardization is aimed at effecting. Again, the producers take the view that the absence of orders for the schedules in question is indicative of there being no real need for them.

However, in respect to the first point, it would seem that they are failing to take into account that the chemical industry is growing at an astounding rate and that its needs for corrosion-resistant piping materials is growing concomitantly; with materials in short supply and mounting in costs, with engineering personnel difficult to come by and relatively, at least, growing scarcer, it is essential to simplify the design, procurement, erection, and maintenance of corrosion-resistant piping systems to the utmost. In this connection, it is not amiss to point out that the loss of revenue occasioned by the shutdown of a chemical process unit for even a day, as might be caused by the failure of a nonstandard component which could not readily be replaced, might far exceed the cost of the piping system in its entirety. From this point of view it may be said, then, that an increase in number of standards in a producing industry could well effect a standardization in the allied producing and consuming industries they serve, with extremely important benefits and, considered from an over all point of view, resulting in ultimate simplification and reduction in cost.

With respect to the absence of apparent demand for Schedules 5S and 10S copper and copper alloy pipe, as evidenced by orders for them, experience demonstrates that purchasers will normally avoid ordering commodities of the type here under discussion when no recognized standard for them exists. The extra cost and the extended deliveries involved are almost always sufficient deterrents to taking such a step.

In view of the extensive use now being made of the light schedules of stainless, aluminum, nickel, and nickel-alloy pipe, with every indication that the volume of these is steadily growing, it will be interesting to see whether copper and copper-alloy pipe will retain their rightful position in the field of corrosion-resistant piping by similarly being made available to consumers, and especially to the vast chemical process industry, in the Schedules 5S and 10S dimensions.

Comment received from G. H. Bohn, Chairman, Task Group 5S and 10S Thickness in Copper and Copper-Alloy Pipe

At a meeting of Subcommittee W-4 of Committee B-5 held on January 24, 1957, the matter of adding Schedules 5 and 10 wall thicknesses to the various copper and copper alloy pipe specifications was discussed. It was pointed out that the identical pipe size outside diameters are covered in the three following ASTM specifications:

Specification Number	Material
ASTM B 42	Copper pipe
ASTM B 43	Red brass pipe
ASTM B 302	Threadless copper pipe

Tube of the Schedules 5S, 10S, 40S or any other wall thickness may be ordered to these specifications by designating the specific wall thickness desired to go along with the listed outside diameters. It should be noted that Specification B 302 standard sizes 1/2 to 2 in., inclusive are even now identical with the 5S Schedule proposed.

Copper pipe or tube may also be ordered by specific outside diameter and wall thickness to ASTM Specification B 75 for Seamless Copper Tube, which covers details of all chemical, mechanical and dimensional tolerances but does not list a specific size series.

Cupro-nickel tubes with outside diameters of pipe size are completely covered by Military Specification MIL-T-16420C, requiring only the designation of the specific wall thickness desired.

An ASTM Specification for Copper-Silicon Alloy Pipe in regular and extra-heavy sizes is up for action in Committee B-5 this year and when finally issued, thicknesses in Schedules 5 and 10 can also be ordered as explained in the first paragraph of this letter.

Copper and brass mills are eager to produce any ordered size of pipe or tube which a consumer may desire, so long as the ordered dimensions are within the mill's individual manufacturing size limitations.

OTHER SOCIETIES' EVENTS

May 1–3—**Society for Experimental Stress Analysis,** Spring Meeting, Exhibit, Hotel Statler, Boston, Mass.

May 1–3—**Electronic Components Conference,** IRE, AIEE, RETMA (sponsors), Hotel Morrison, Chicago, Ill.

May 5–9—**American Ceramic Society,** 59th Annual Meeting, Statler-Hilton Hotel, Dallas, Tex.

May 6–9—**Building Officials Conference of America,** Annual Conference, Jung Hotel, New Orleans, La.

May 6–10—**American Foundrymen's Society,** First Engineered Castings Show and 61st AFS Castings Congress, Cincinnati Music Hall, Cincinnati, Ohio.

May 12–16—**Electrochemical Society,** Spring Meeting, Hotel Statler, Washington, D. C.

May 12–17—**American Water Works Assn.,** Annual Convention, Atlantic City, N. J.

May 14–16—**Armour Research Foundation,** 2nd Annual Industrial Nuclear Technology Conference on Applied Uses of Radiation, Chicago Museum of Science and Industry, Chicago, Ill.

May 16–18—**American Institute of Industrial Engineers,** Annual National Conference and Convention, Statler Hotel, New York, N. Y.

May 16–18—**Society of Naval Architects and Marine Engineers,** Spring Meeting, Lafayette Hotel, Long Beach, Calif.

May 18–27—**Institute of Radio Engineers** National Convention, Waldorf Hotel, New York, N. Y. Exhibit at Coliseum.

May 20–21—**Society of American Military Engineers,** 37th Annual Meeting, Washington, D. C.

The Development of Drain Tile Specifications in ASTM—A Brief History

By DALTON G. MILLER[1]

THE formulation of the specifications on drain tile, one of the oldest ASTM standards, was originally under the jurisdiction of Committee C-6 on Drain Tile, created by action of the Executive Committee (now Board of Directors) of the Society in 1911. Dean Anson Marston of Iowa State College was chairman of Committee C-6 for the entire 37 years of its existence. Committee C-6 was abolished in 1948 and its functions transferred to Subcommittee X on Drain Tile of ASTM Committee C-15 on Manufactured Masonry Units. Dalton G. Miller, materials engineer, Bureau of Public Roads, U. S. Department of Commerce, was chairman of Subcommittee X from 1948 until 1955, when the chairmanship was taken over by John G. Sutton, drainage engineer, Engineering Division, Soil Conservation Service, U. S. Department of Agriculture.

Through the years from 1911 to 1955, the drain tile specification development in ASTM, first in Committee C-6 and later in Subcommittee X of Committee C-15, functioned for both clay and concrete drain tile encompassed in one standard. Such an arrangement had the advantage of common interest in problems related to the whole field of tile drainage, but it presented difficulties caused by representatives of two competing materials working together as one group on the development of specifications acceptable to both the clay and the concrete interests. The ASTM Board of Directors took official cognizance of this in 1955 to the end that the preparation of specifications for concrete drain tile is now the responsibility of Subcommittee III of Committee C-13 on Concrete Pipe while the responsibility for specification requirements for clay drain tile remains in Subcommittee X of Committee C-15 on Manufactured Masonry Units. Philip W. Manson, professor of agricultural engineering, University of Minnesota, is presently chairman of Subcommittee III of C-13 and J. G. Sutton continues as chairman of Subcommittee X of Committee C-15.

Presumably future ASTM specifications for clay and concrete drain tile will be issued separately. The Specifications for Drain Tile (C 4) were published as standard from 1914 to 1950, having been revised in 1916, 1921, and 1924. They were revised and reverted to tentative in 1950 and published as tentative from 1950 to 1955 with a revision in 1954. They were adopted as standard in 1955.

The revisions of 1916, 1921, and 1924 were chiefly editorial, and it was not until 1950, 26 years later, that any major changes were made. Even after the specifications were rewritten in 1950, most of the sections are basically as they were in 1914—a tribute to the foresight of the original membership of former Committee C-6. Specification C 4 – 55 is considerably shorter than the 1914 version, due chiefly to deletion of material pertaining to the freezing apparatus which had become obsolete with the advent of mechanical freezing units.

The principal change made in 1950 was a reduction in the number of classes of drain tile from three to two. This was done by deletion of "Farm Drain Tile," since it was felt that the physical requirements were too low to justify ASTM recognition for the reason that almost any drain tile produced, whether clay on concrete, would in all probability have physical properties better than specified under "Farm Drain Tile." Whether this is sufficient reason for not specifying drain tile lower in quality than "Standard" has been subject to some argument.

Strength Requirements

It is obvious that tile should have sufficient strength to support the loads imposed without cracking when a ditch is backfilled. There have been few changes in the minimum supporting strengths stipulated in the ASTM standard specifications as these strengths seem to have been adequate for tile installed at moderate depths in relatively narrow ditches where the bedding conditions for the tile are reasonably good. Numerous nomographs based on accepted formulas are available for estimating loads on tile to be installed under conditions which are unusually severe.

Absorption Requirements

The maximum limitations of absorption prescribed by the ASTM standard specifications are, and have been from the first, different for concrete tile than for clay tile. There have been many comments and questions regarding this from a number of sources through the years, even though the reasons for a difference are logical and readily explained as follows:

5-Hr Absorption Test

It is the rule that underburned clay products, irrespective of the reason for underburning, are relatively high in absorption and low in resistance to the deleterious effects of freezing and thawing. The upper limits of absorption of clay drain tile stipulated in the ASTM specifications are those that are presumed to be such as will insure that clay tile below these limits will be high in frost resistance. It sometimes happens that clay products become glass brittle when extremely hard burned and may crack when subjected to extremes of weather changes. However, this is never a serious matter with drain tile. It is also true that clay products from some plants may be relatively high in absorption and still be resistant to frost action. Thus, the per cent absorption is more significant as regards the relative frost resistance for clay tile from a given plant than it is for tile from different plants. In other words, tile from a given plant will generally increase in frost resistance as the absorption decreases, whereas this absorption-frost-resistance pattern may not hold when comparing test results of tile from different plants. It is for this reason that the drain tile specifications of ASTM have a provision for recourse to an actual freezing-and-thawing test whenever a manufacturer, or other seller of clay drain tile, so demands. This protects a clay tile producer from undue discrimination because his product is relatively high in absorption but is also relatively high in frost resistance. Actually, the absorption requirement of the ASTM standard specifications is merely a short-cut

[1] Materials engineer (retired) Bureau of Public Roads, U. S. Department of Commerce, University of Minnesota.

method for the determination of frost resistance.

Leakage Test

Limited research at the University of Minnesota indicates that a leakage test under moderate heads may be a better indicator of concrete tile durability than the standard 5-hr boiling test. It would be well to explore possibilities of a better test for clay tile than the 5-hr boiling test.

Conclusion

The original membership as shown in the records of the organizational meeting of Committee C-6 held September 28 and 29, 1911, consisted of men of high caliber representing industry and engineering. (See ASTM *Proceedings* for 1914, Vol. 14; Part 1, p. 208.) These men were, without exception, leaders in their respective fields, with many becoming world authorities. This should inspire all in the field of agricultural drainage, in whatever capacity, to aim at high standards of performance.

Electroplating from Organic Solutions

THE National Bureau of Standards has succeeded in electrodepositing several of the refractory and light metals or their alloys from organic solutions. The metals deposited include beryllium and alloys of magnesium, titanium, or zirconium with aluminum. The deposits were produced by plating techniques developed in connection with a Bureau program to seek means for electrodepositing metal coatings and electroforming the refractory metals. In the course of the work, improvements have also been made in the new process for electrodepositing aluminum. Except for aluminum, the plating of the refractory and light metals is not yet commercially practicable.

The refractory and light metals have many special properties which make them particularly important to modern industry and the armed services. Titanium and zirconium are corrosion resistant and have relatively high melting points. They are also light and strong. Titanium has a larger ratio of strength to density than aluminum. These metals would thus be very valuable either as protective coatings on other metals or for electroforming. However, their deposition potentials are so far above hydrogen in the electromotive series that none of them can be deposited from aqueous solutions. The Bureau therefore decided to investigate fused salts and organic solutions as baths for electrodepositing the light and refractory metals. In the present studies, the best deposits of these metals were obtained from halides, hydrides, borohydrides, and organometallic compounds, dissolved in ether. Fused salts baths yielded the metals only in the form of powder, flakes, or dendrites.

New Atmospheric Exposure Tests of Non-Ferrous Metals

IN 1955 the results of the 20-year data from tests of non-ferrous metals and alloys exposed in 1931 were summarized in a symposium on Atmospheric Corrosion of Non-Ferrous Metals (*STP No. 175*), presented at the Society's Annual Meeting.

In June, 1956, members of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys were canvassed to determine the degree of interest in a new test program embracing the metals and alloys that have become commercially important in the last 25 years. More than one third of the members of Committee B-3 expressed their views in favor of a new program.

Suggestions for metals to be tested in the new program included aluminum, magnesium, titanium, zirconium, copper, cupro-nickel, and zinc. In addition, there were 19 other metals suggested by single individuals. In order to make a definite recommendation to the committee, producers (both ASTM members and otherwise) were consulted for information on alloys used in appreciable quantities for atmospheric corrosion-resisting service, or in applications where resistance to atmospheric corrosion is important. Information was also obtained on alloys expected to play a part in service of this type in the near future (next ten years).

As a result of these inquiries, offers have been received indicating cooperation in supplying specimens of the following metals and alloys: 16 aluminum alloys, 18 copper alloys, lead (6 per cent antimony), 4 magnesium alloys, 2 molybdenum alloys, 5 nickel alloys, stainless steel, type 302 (for comparison purposes), tantalum (commercial grade), 8 titanium alloys, 2 zinc alloys, and zirconium (commercial grade).

In addition to the above, it has been recommended that consideration be given to inclusion of superpurity aluminum (99.99 per cent min Al), beryllium alloys, and Zircaloy-2.

On the basis of the returned questionnaires and the correspondence with producers, a new atmospheric exposure test program is projected as follows:

Test Sites:

Kure Beach, N. C. (east coast marine),
State College, Pa. (rural),
New York Area (Newark, N. J.) (industrial), and
Point Reyes, Calif. (west coast marine).

Test Periods:

Initial tests (zero point),
2, 7, and up to 20 years' exposed, and
2, 7, and up to 20 years' storage.

Type of Tests:

Chemical analyses,
Thickness measurements before exposure,
Weight change after exposure (after cleaning),
Tension tests (two specimens per panel after cleaning and weighing), and
Pit depth (center section of each panel after removal of tension specimens).

Test Specimens:

All from one heat, 8 by 4 by 0.05 in. in size. The 8-in. length will permit a standard tension specimen and 4-in. width will permit two standard tension specimens with sufficient area remaining for pit depth determination. The 0.05-in. thickness will better resist penetration due to pitting and will be less susceptible to fatigue effects from wind action.

Triplicate specimens for each period:
Triplicate specimens for weight loss,
Triplicate specimens for pit depth, and
Sextuplicate specimens for tension tests.

Total specimens per alloy 44, at four locations:
Initial tests (2), three exposure periods (36), three storage periods (6), and
Triplicate specimens for exposure; duplicate for initial and storage (3 tension specimens per panel).

The Task Group has been empowered to decide what alloys should be included and to proceed with arrangements for acquisition, testing, storage, and exposure of specimens, and for the necessary test site facilities.

Comments on this program received before the Annual Meeting would be appreciated and should be sent to the Task Group Chairman, J. S. Pettibone, Inco Research Laboratory, Post Office Box U, Bergen Point Station, Bayonne, N. J.

The Bookshelf

Technique of Organic Chemistry. Vol. III, Part I: Separation and Purification

Edited by Arnold Weissberger, Interscience Publishers, New York, N. Y., 873 pp., $17.50.

ALTHOUGH separation techniques have been given considerable attention in recent years, chromatography, adsorption, and ion exchange have been written about so much that they have, to a certain extent, overshadowed many of the other techniques employed for separations. It is therefore a pleasure to see a comprehensive volume on separation and purification that is devoted to techniques such as diffusion, extraction, crystallization, etc. The second edition of *Separation and Purification* makes available a volume that will be most useful to most chemists and chemical engineers.

The second edition is a completely revised and expanded version of the first edition. The topics of distillation, adsorption, and chromatography have been omitted since they are now well covered by Vols. IV and V of this series.

Diffusion, extraction, crystallization, centrifuging, filtration, and solvent removal are covered by thirteen authors, all experts in their field, and ably edited by Arnold Weissberger. Each topic covers both the theory and practice of the particular technique in a manner that will make the volume attractive to all scientists.

Each section is a complete book in itself. In particular, the section entitled "Laboratory Extraction and Countercurrent Distribution" written by L. Craig and D. Craig and supplemented by a section on "Increased Quantities" by E. G. Scheibel is 244 pages in length and represents a thorough coverage of the field of extraction and countercurrent distribution. The section on "Crystallization and Recrystallization" by R. S. Tipson may also be considered a complete text in itself.

The section entitled "Diffusion Methods" is most interesting since it covers a field not too well described in the literature and deals with several techniques that are most useful but not well known to the average chemist and engineer. This section is in four parts and includes "Thermal Diffusion of Organic Liquids" by A. Letcher Jones, "Barrier Separations" by K. Kammermeyer, "Dialysis and Electrodialysis" by R. Eliot Stauffer and "Zone Electrophoresis" by E. MacWilliam.

Although the sections entitled "Centrifuging" by C. M. Ambler and F. W. Keith, Jr., "Filtration" by A. B. Cummins and F. B. Hutto, Jr., and "Solvent Removal, Evaporation, and Drying" by G. Broughton are topics more familiar to the chemical engineer than to the chemist, they are written in a style and contain much information that will render them equally useful to the chemist.

The only criticism that might be made of the volume is that it is part of a series of volumes entitled "Technique of Organic Chemistry" and might therefore lead some to believe that the book is of value primarily to those working in the field of organic chemistry. There is little doubt in the mind of the reviewer that this book will find itself in the hands of many inorganic, physical, and analytical chemists as well as organic chemists.

ROBERT KUNIN

Composition and Properties of Concrete

G. E. Troxell and H. E. Davis with Chapters by J. W. Kelly, McGraw-Hill Civil Engineering Series, New York, N. Y., 420 pp., $7.75.

THIS book is an excellent compilation of information on the composition and properties of concrete. Today, more than ever before, the civil engineer is required to give thought and time to the problems of concrete making and utilization. The results accomplished in the field by the construction engineer and the concrete inspector depend upon their knowledge of concrete and of the materials from which it is made. The characteristics and properties of concrete-making materials —cements, aggregates, water, admixtures, and miscellaneous materials— are described. The proportioning and mixing of these materials, as well as the placing and curing of the concrete, to produce a finished product of suitable and predictable quality and economy are covered.

Several chapters are devoted to the properties of concrete, their significance, and how they are affected by the many steps involved in the fabrication of the product. Attention is given, not only to ordinary concrete as used in structures and highways but also to the problems involved in mass concrete, lightweight concrete, heavyweight concrete, and other special concretes. The significant properties of concrete, such as strength, durability, permeability, volume changes, creep, elastic properties, thermal properties, fire-resistance, and unit weight are described. The problems encountered by the inspector and information on the usual records that he must keep and methods of evaluation of test data are included.

Part II comprises instructions for tests that have been selected to illustrate the most important facts and principles connected with the use of cement, aggregate and concrete. A list of references, classified by subject, and reference to ASTM specifications and methods of testing are included.

W. E. LERCH

An Introduction to Modern Organic Analysis

Sidney Siggia and Hans J. Stolten, Interscience Publishers, Inc., New York, N. Y., 250 pp., $4.50.

THIS is a short book on a big subject. Modern organic analysis embodies the principles of modern chemistry, physics, and instrumentation and comprises numerous techniques, which are often scattered and separated by departmental barriers in university and industrial laboratories. Authoritative texts have been written on many of these techniques.

This book brings together in one volume the many different techniques of organic analysis and discusses the general principles involved, the type of information derived, and the strong points and limitations of each. It is the purpose of this book to consolidate the entire field of organic analysis from the viewpoint of the analytical chemist and to emphasize the line of reasoning and thinking essential to the rapid, precise, and accurate solution of analytical problems.

The book will be especially useful to the classroom teacher and to the beginning student on the subject. Suggested laboratory exercises and problems are included, and reference to more extensive texts given at the end of each chapter. It will be useful also to the industrial analytical specialist who desires a perspective of the whole field or who is seeking additional approaches. A good knowledge of chemistry and physics is presupposed.

The opening chapter points out that the organic analytical problem is almost always a part of a broader chemical problem on which the analyst must be informed, and which he must consider with the synthesis and the production chemists. No single approach can be adopted for all problems. The different analytical tools for attacking the organic analytical problem are listed and the importance of correlating all the information is emphasized.

Succeeding chapters discuss elemental analysis, functional group analysis, potentiometric titrations, absorption spectroscopy, freezing point, polarographic analysis and amperometric

titrations, X-ray diffraction, refractive index and density, methods of separation and specialized approaches. Typical problems illustrating the inter-relationship of these several analytical approaches are presented in the final chapter. The 50-page chapter entitled Absorption Spectroscopy is especially good.

Considering the usual sequence of an analysis, the chapter on Methods of Separation could have been placed first in the book, with some discussion of sampling and the preparation of samples for analysis. Also question might be raised on selection of the title Specialized Approaches for the chapter on microscopy, mass spectrometry, Raman spectroscopy, and polarimetry. With the possible exception of Raman spectroscopy, these other approaches are no more specialized than many of those discussed more fully.

Despite its small size, this book provides a valuable introduction to the whole field of organic analysis.

W. A. KIRKLIN

Education and Industry at Work for Progress

Cornelius Wandmacher, Ed., University of Cincinnati, Cincinnati 21, Ohio

THROUGH the courtesy of Professor Wandmacher, head of the Department of Civil Engineering, we recently received at ASTM Headquarters copy of this 168-page "memento" of the 50th Anniversary Observance of the founding of cooperative education at the University of Cincinnati. The Observance was in the form of a 2-day conference and week-long exhibition in April, 1956, in which education and industry joined to portray the results of the cooperative educational method launched in 1906 by Dean Herman Schneider, and now in use in no less than thirty-four other colleges and universities. At the dedication of the Herman Schneider Quadrangle on the campus, President Emeritus Raymond Walters noted the philosophical basis of the cooperative system as expressed by its founder: "Theory can best be learned in school; an understanding of man and his mechanisms can be learned only where they operate. The major idea is that of balanced training." President Walter C. Langsam, in his foreword to the historical commemoration record states: "This cherished achievement is based on something that far transcends a campus philosophy. It is based on the persuasion of a whole community that business, industry, the professions, and the University could and would join hands in a unique and effective program."

Professor Wandmacher, who was chairman of the University Committee for the Observance, has indicated that some copies of this interesting and well-illustrated historical record are available "for reference libraries and for interested persons who may not have been included on the initial mailing list."

Testing of Weighing Equipment

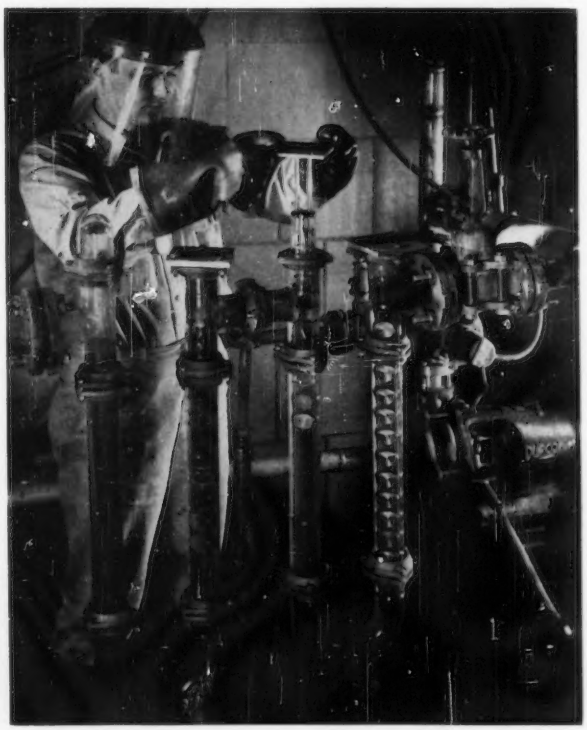
National Bureau of Standards Handbook H37 (reprint) 184 pp., $1.25 (Order from the Government Printing Office, Washington 25, D. C.)

THIS publication, a standard reference in the field of weights and measures, has been reprinted because of public demand. It is one of a series of handbooks designed to present in compact form comprehensive information relative to weights and measures supervision. H37 also describes various types of scales and weights, the principles of their operation, and methods for their inspection and test.

Although this handbook was prepared primarily for use by weights and measures officials of the states, counties, and cities, much of the information presented also has proven to be of interest and assistance in maintaining weighing equipment in commercial and industrial establishments.

Curing of Concrete

CURING of Concrete 1925–1955 is the subject of *Bibliography 18* recently published by the Highway Research Board. The bibliography is a comprehensive coverage of literature from the United States and Canada on the subject. Much credit for its preparation is due Floyd O. Slate of Cornell University. The bibliography may be purchased from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C., at $1.80 per copy.



Dynamic Corrosion Testing. *Honorable mention, general photographs, black & white*—Tenth ASTM Photographic Exhibit. William W. C. Wilke, Jr., Crane Co. Chicago, Ill.

FEDERAL GOVERNMENT STANDARDS INDEX CHANGES

THE General Services Administration of the Federal Supply Service is charged with the responsibility for establishing specifications to be used by the Federal Government for procurement of materials and supplies. The GSA issues an annual Index of Initiation of Federal Specifications and Federal Standards Projects, and monthly supplements.

Items listed below appeared in Supplements Nos. 10 and 11 for the months of December, 1956, and January, 1957.

Comments from industry are requested and should be addressed to Willis S. MacLeod, Director, Standards Division, General Services Administration, Federal Supply Service, Washington 25, D. C.

INITIATIONS

Title	Type of Action	Symbol or Number	FSC Code	FSSC Class	Assigned Agency & Preparing Activity
Aluminum-Alloy Forgings, Heat Treated	Am. 1	QQ-A-367d	9450	46	DOD-Navy-Aer
Barrier Materials, Waterproof, Flexible	New New	PPP-B-125 PPP-B-00125	8135	..	COM-BDSA
Bearings, Ball, Annular (General Purpose)	Rev.	FF-B-171a	3110	77	DOD-Navy-Ships
Bearing, Ball and Roller, Radial and Thrust	New	FF-B-174	3110	77	DOD-Navy-Ships
Bearings, Roller, Cylindrical; and Bearings, Roller, Self-Aligning	Rev.	FF-B-185	3110	77	DOD-Navy-Ships
Bearing, Roller Needle	New	FF-B-189	3110	77	DOD-Navy-Ships
Calcium Chloride, Dihydrate, Technical	Rev.	O-C-106b	6810	..	GSA-FSS
Cans, Metal, 28 Gage and Lighter	Rev. New	PPP-C-96 PPP-C-0096	8110	..	COM-BDSA
Cleaning Compound, Solvent, Grease Removal, Heavy Duty	New	P-C-443	..	..	DOD-Navy-Ships
Drums, Fiber	Rev. New	PPP-D-723 PPP-D-00723	8110	..	COM-BDSA
Drums: Metal, 55-Gallon (for Shipment of Noncorrosive Materials)	New Rev.	PPP-D-729 PPP-D-00729	8115	..	COM-BDSA
Enamel; Gloss, Synthetic (for Exterior and Interior Surfaces)	Rev.	TT-E-489c	8010	52	DOD-Army-Ord.
Enamel, Semi-Gloss, Rust-Inhibiting	Rev.	TT-E-485d	8010	52	DOD-Army-Ord.
Enamel, Synthetic, Lustreless	Rev.	TT-E-527a	8010	52	DOD-Army-Ord.
Fiberboard, Corrugated, or Indented or Molded (Flexible)	New	PPP-F-291 PPP-F-00291	8135	..	COM-BDSA
Hose; Gasoline, Synthetic-Rubber, Wire-Stiffened	Rev.	ZZ-H-471a	4720	..	DOD
Leaded Tin Bronze Castings and High Leaded Tin Bronze Castings	New	QQ-L-225	..	95	DOD-Army-Ord.
Methanol (Methyl Alcohol)	Rev.	O-M-232a	6810	..	GSA-FSS

INITIATIONS

Title	Type of Action	Symbol or Number	FSC Code	FSSC Class	Assigned Agency & Preparing Activity
Method 223.11 of Federal Specification SS-R-406c Road and Paving Materials; Methods of Sampling & Testing Joint Sealer, Hot-poured & Cold Application Types	Am.	SS-R-406c	..	..	COM-BPR
Oil, Insulating (for Transformers, Switches and Circuit Breakers)	Rev.	VV-O-401a	9150	..	DOD-Army-Ord.
Packaging, Packing and Marking of textile Fabrics, Woolens, Worsted, Cotton, Silks and Synthetics	Am. 1	PPP-P-51	8305	..	DOD-Army-QMC
Paint; Primer, Zinc Yellow, for Aluminum and Magnesium Surfaces	Rev.	TT-P-666a	8010	52	DOD-Army-Ord.
Paper, Bond and Writing, White and Colored	Rev.	Fed. Std. 53a	7510	53	GSA-FSS
Plastic, Acrylic, Extruded Sheeting	New	L-P-330	9330	..	COM-NBS
Sealing Compound, Cold-Application Ready-Mixed Liquefier Type (for Joints in Concrete)	New	SS-S-00158	8030	..	COM-BPR
Sealing Compound; Cold-Application Mastic Multiple Component Type (for Joints in Concrete)	New	SS-S-00159a	8030	..	COM-BPR
Sealing Compound, Two-Components, Jet Resistant, Cold Applied, Concrete Paving	Rev.	SS-S-170	5610	..	DOD-Army-CE
Silver Plating (Electrodeposited)	Rev.	QQ-S-365	..	..	DOD
Soap, Borax, Powder (for Dispensers)	Rev.	P-S-628b	8520	51	DOD-Navy-Ships
Strapping, Flat; Steel	Rev.	QQ-S-781b	8135	..	DOD-Navy-Ships
Strapping, Round; Steel, Bare and Zinc-Coated QQ-S-790a issue in effect)	New	...	..	..	GSA-FSS
Tape, Cotton, Bleached, Dyed, or Gray, General Use	Rev.	DDD-T-86	8315	83	DOD-QMC
Tolerances for Steel and Iron Wrought Products —Change Notice	Am.	Fed. Std. 48	..	..	DOD-Bu-Ships
Wire, Steel, Corrosion (and Heat) Resisting, Cold Heading & Cold Forging	New	QQ-W-00426	9505	..	GSA-FSS
Wire, Steel, Carbon (Round, Bare and Coated)	New	QQ-W-00461c	9505	..	GSA-FSS

TITLE AND SYMBOL CHANGES

Title	Type of Action	Symbol or Number	Former Title or Symbol
Antifreeze, Ethylene Glycol, Inhibited	Rev.	O-A-548 & O-A-00548	Ethylene Glycol, Inhibited (O-E-771b)
Leather, Cattlehide (Mineral-Tanned, Hydraulic Packing)	New	KK-L-163	Leather, Cattlehide, Mineral-Tanned (Hydraulic Packing)
Leather, Cattlehide, (Insole)	New	KK-L-159	Leather, Cattlehide, Insole

WITHDRAWALS

Title	Type of Action	Symbol or Number	Assigned Agency & Preparing Activity	Reason for Withdrawal
Aluminum Alloy Bars, Rods, and Structural and Special Sections - Extruded, 6063 (63S)	New	...	DOD-Navy-Ships	No need for item
Bronze, Tin; Castings	Rev.	QQ-B-691b	DOD-Army-Ord	Title and number changed
Leather, Cattlehide, Insole	Rev.	KK-L-191a	GSA-FSS	Withdrew KK-L-191a for purpose of initiating new specification KK-L-159
Leather, Cattlehide, Mineral-Tanned (Hydaulic Packing)	Rev.	KK-L-177c	GSA-FSS	Withdrew KK-L-177c for purpose of initiating new specification KK-L-163
Strapping, Flat; Steel	Am. 1	QQ-S-781b	DOD-BuShips	Being changed to a revision
Wire, Steel, Corrosion & Heat Resisting, for Cold Heading & Cold Forging	New	...	GSA-FSS	Being issued as an Interim Federal Specification

CANCELLATIONS

Title	Symbol or Number	Reason for Cancellation
Adhesives; Methods of Testing	MMM-A-175	Superseded by Fed. Test Method Std. 175
Boxes, Fiberboard, Wood-Cleated (for Domestic Shipment)	NN-B-591a	Superseded by Fed. Spec. PPP-B-59
Colors; (for) Ready-Mixed Paints	TT-C-595	Superseded by Fed. Std. No. 595

Enamel; Interior, Semigloss, Tints and White	TT-E-0508 & Notice 1-TT-E-508	.....
Enamel-Undercoat, Interior, Tints & White	TT-E-0543 & Notice 1-TT-E-543	.....
Iron and Steel; Sheet, Tinned (Tin-Plate)	QQ-I-706a	Superseded by Fed. Spec. QQ-I-706
Methacrylate Plastic Sheets, Rods, and Tubes	L-M-191	Superseded by Fed. Spec. L-P-391
Rope; Manila	T-R-601a	Superseded by Fed. Spec. T-R-605
Rope; Sisal	T-R-631	Superseded by Fed. Spec. T-R-605
Sheeting; Cotton, Bleached, Wide	CCC-S-271a	Superseded by Fed. Spec. CCC-C-43
Sheeting; Cotton, Unbleached, Wide	CCC-S-291a	Superseded by Fed. Spec. CCC-C-43
Testers; Antifreeze-Solutions	GG-T-241	Superseded by Fed. Spec. GG-H-935

PROMULGATIONS

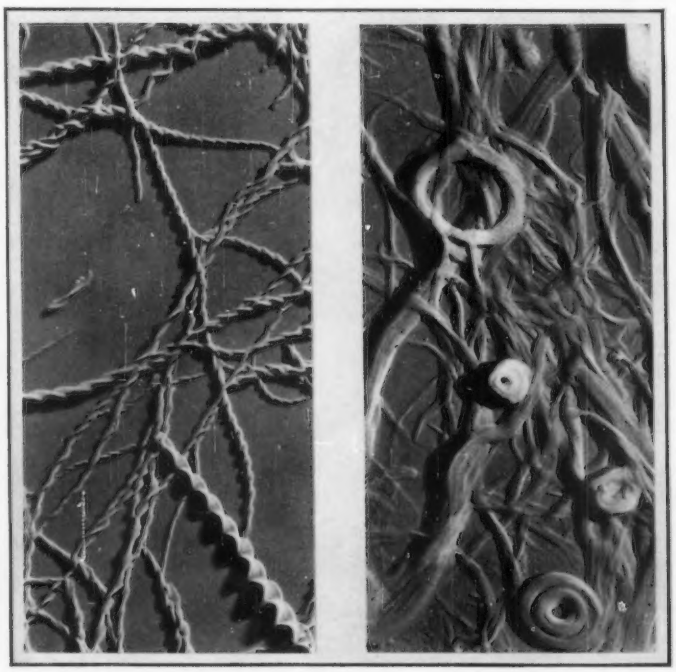
Title	Type of Action	Symbol or Number
Adhesives: Methods of Testing	New	Fed. Test Method Std. No. 175
Adhesive, Polyvinyl Acetate Resin Emulsion (Alkali Dispersible) (Superseding Int. Fed. Spec. MMM-A-00180(VA)	New	MM-A-180
Cable and Wire; Weather-Resistant	Am. 2	J-C-145
Enamel, Semi-Gloss, Rust-Inhibiting	Am. 1	TT-E-485c
Leaded Tin Bronze Castings and High Leaded Tin Bronze Castings (Superseding Int. Fed. Spec. QQ-B-00691b(Army-CE) and Fed. Spec. QQ-B-691b)	New	QQ-L-225
Leather, Cattlehide (Insole) (Superseding Int. Fed. Spec. KK-L-00191a(COM-NBS) and Fed. Spec. KK-L-191)	New	KK-L-159
Leather, Cattlehide (Mineral-Tanned, Hydraulic Packing) (Superseding Int. Fed. Spec. KK-L-00177c(COM-NBS) and Fed. Spec. KK-L-177b)	New	KK-L-163
Lubricants, Liquid Fuels, and Related Products; Methods of Testing	Change Notice 1	Fed. Test Method Std. No. 791
Paint, Latex Base, Interior, Flat White and Tints	Am. 1	TT-P-29
Paper, Bond & Writing, White & Colored	Rev.	Fed. Std. No. 53a
Pipe-Clay, Sewer	Am. 1	SS-P-361b
Pipe, Steel (Seamless and Welded, Black and Zinc-Coated (Galvanized) (Superseding Fed. Spec. WW-P-404)	Rev.	WW-P-404a
Plating, Cadmium (Electrodeposited) (Superseding Fed. Spec. QQ-P-416)	Rev.	QQ-P-416a
Shingles: Asbestos Cement (Roofing) (Superseding Fed. Spec. SS-S-291b)	Rev.	SS-S-291c
Siding (Shingles, Clapboards, and Sheets) Asbestos-Cement (Superseding Fed. Spec. SS-S-346a)	Rev.	SS-S-346b
Sweeping Compound (Superseding Int. Fed. Spec. P-S-00863a(GSA-FSS) and Fed. Spec. P-S-863)	Rev.	P-S-863a
Turpentine; Gum Spirits, Steam Distilled, Sulfate Wood, and Destructively Distilled (Superseding Int. Fed. Spec. TT-T-00801a(AGR-AMS) and Fed. Specs. TT-T-801 and TT-T-806)	Rev.	TT-T-801a

INTERIM FEDERAL SPECIFICATIONS ISSUED

Title	Type of Action	Symbol or Number
Bearings, Roller, Tapered	New	FF-B-00187(Navy-Ships)
Bolts, (Square Neck, Machine, Ribbed Neck, Finned Neck, Tee Head, Key Head) (Round Head)	New	FF-B-00584(COM-NBS)
Calcium Chloride, Dihydrate, Technical	New	O-C-00106b(GSA-FSS)
Methanol (Methyl Alcohol)	New	O-M-00232a(GSA-FSS)
Paper, Toilet Tissue	New	UU-P-00556b(GSA-FSS)
Sealing Compound; Cold-Application Mastic Multiple Component Type—For Joints in Concrete	Rev.	SS-S-00159a(COM-BPR)
Steel Bars, Shapes, and Forgings-Corrosion Resisting	Am. 3	QQ-S-00763a(Navy-Ships)
Wire, Steel, Carbon (Round, Bare, and Coated)	New	QQ-W-00461c(GSA-FSS)
Wire, Steel, Corrosion (and Heat) Resisting Cold Heading and Cold Forging	New	QQ-W-00426(GSA-FSS)

SPECIFICATIONS and STANDARDS APPROVED FOR PRINTING

Title	Type of Action	Symbol or Number
Aggregate: (for) Portland-Cement-Concrete	Am. 1	SS-A-281b
Belting: Flat, Leather, Vegetable-Tanned	Am. 1	KK-B-201c
Bronze; Castings	Canc.	QQ-B-691b
Copper-Nickel-Alloy; Castings	Canc.	QQ-C-551
Leather; Insole	Canc.	KK-L-191
Lubricants, Liquid Fuels, and Related Products Methods of Testing	Change Notice 1	Fed. Test Method Std. 791
Plastic Sheet, Modified Unplasticized Polyvinylchloride, Rigid	Am. 1	L-P-510
Turpentine; Wood (Destructively-Distilled) (for Use in Organic Coatings)	Canc.	TT-T-806



Soap Fibers in Greases

Third prize, Electron Micrographs, Films, Fibers & Particles, Tenth ASTM Photographic Exhibit. John A. Johnson, Westinghouse Electric Corp., East Pittsburgh, Pa.

Protective Coating Adhesion Measurement Using an

Electronic Averaging Device for the Adherometer

By A. G. ROBERTS and R. S. PIZER

The speed and ease of operation of this improved adherometer and the precision of the measurements have been increased considerably beyond that previously attainable

Because of the great importance of good adhesion in the service performance of protective coatings, much effort by many investigators has been directed, with only partial success, toward the development of test methods that would permit laboratory evaluation of the adhesion property.[1] The Interchemical adherometer (**1,2**), although one of the more promising methods available, does not always give reliable results and suffers from uncertainties in interpretation of the values yielded. This instrument measures the force required to strip a unit thickness of coating from its substrate as the coating, mounted on a motor-driven plate, travels under a weighted knife. The stripping force is supplied by a pendulum attached to an eccentric cam in contact with the foot of a dial gage whose readings are proportional to the angular displacement of the pendulum. The force is a sinusoidal function of the angular displacement. Gage readings are converted to force units by reference to a calibration chart.

Previous work in the authors' laboratory (**3**) with the adherometer indicated that the reliability of results would be considerably improved if the variable stripping force encountered could be averaged by some means; it was suggested, in a general way, that this might be accomplished by translating the variable stripping force into a variation in an electronic circuit whose output would actuate a standard recorder to give a graph from which the average value of the stripping force could then be obtained. Brantley and co-workers (**4**) have since employed a mechanical pen and revolving drum to obtain such a graph.

This paper describes equipment which not only translates the variable adherometer stripping force into electrical impulses but also sums these varying impulses to give a single average value that can be read directly either from a voltmeter or a standard recorder. The speed and reliability of adherometer measurements have thus been significantly improved. The new apparatus is called the NBS Integrometer.

Description of Apparatus

The apparatus for accomplishing the averaging operation consists basically of three parts: (1) a source of stripping force combined with a sensing element

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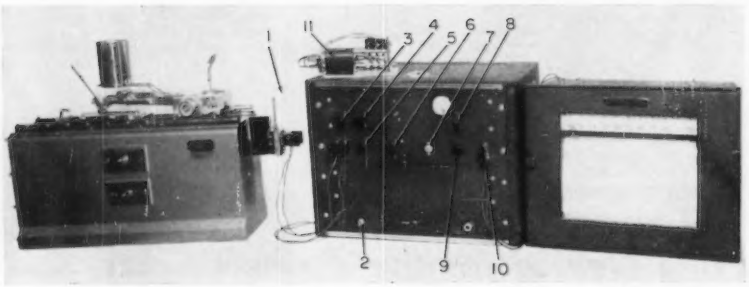
NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.



1 Beam and strain gage assembly
2 On-off switch
3 Fine zeroing control (capacitive)
4 Fine zeroing control (resistive)
5 Coarse zeroing control
6 Range switch
7 Start button
8 Function selector
9 Recorder zero adjust
10 Integrator output terminals
11 Motor-driven automatic switching assembly

Fig. 1.—Complete apparatus, including adherometer, integrometer, and recorder (see legend).

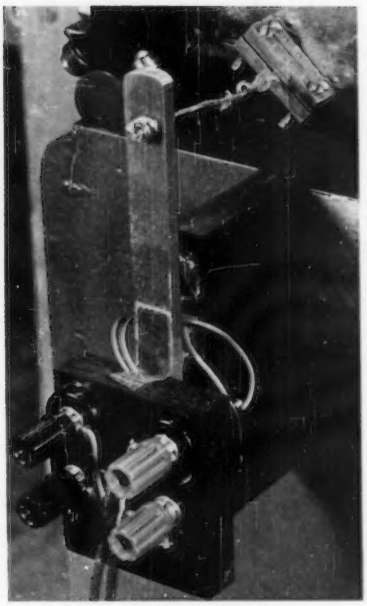


Fig. 2.—Close-up of beam and strain gage assembly.

that varies with the magnitude of the force, (2) an electronic amplifying and integrating device which converts variations in the sensing element into varying electrical impulses and sums them, and (3) a voltmeter or recorder to indicate, or to provide a written record of, the output from the integrator. The complete apparatus, including adherometer, integrometer, and recorder, is shown in Fig. 1.

Basic Operation

To provide a means for converting adherometer stripping force values into electrical impulses, the pendulum normally employed as a source of the stripping force needed at the cutting head is replaced by an aluminum alloy beam with strain gages attached to both faces (Fig. 2). The beam is of $\frac{3}{16}$-in. thick 24S-T aluminum alloy. The strain gages form part of a Wheatstone bridge circuit inside the integrometer. The bridge is energized from a built-in 5000-cycle oscillator and is balanced for zero output before a test run. Bending of the aluminum beam during a stripping run produces an electrical unbalance in the bridge. This unbalance is amplified and, after rectification, is fed into an integrating circuit having a long-time constant compared with the time for a stripping run; thus, the build-up of voltage across the integrating network is practically linear for a constant applied voltage and is directly proportional to the magnitude of whatever varying voltages are being impressed upon it as a consequence of varying stripping force at the cutting head. The output from the integrator is fed, through an appropriately designed meter circuit, to a conventional recorder[2] which draws a straight line whose length after a precisely timed interval is proportional to the average value of the varying voltage that has been impressed on the integrator during the stripping operation. The length of a stripping run is automatically controlled and is always the same, so that the results obtained for any number of stripping runs are directly comparable. If desired, a voltmeter may be used in place of the recorder to follow the voltage build-up across the integrating network; in this case, the maximum value reached by the meter during the timed interval is proportional to the average value of the stripping force during that interval.

The average voltage values derived from the integrometer are converted into units of average stripping force by reference to a calibration curve obtained by plotting the output voltages yielded by known loads applied to the aluminum beam for the standard time interval. A fixed electrical unbalance can be introduced into the bridge at the flick of a switch to provide a calibration reference point. Subsequent drift in the electrical characteristics of the amplifier

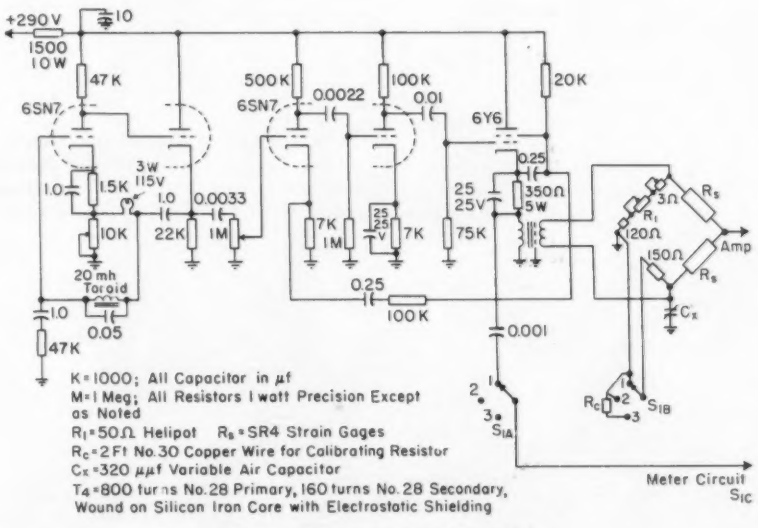


Fig. 3.—Oscillator and bridge drive.

[2] In recorders having a built-in thermocouple-compensating unit, the unit must be replaced with a fixed resistor to obtain proper operating stability.

circuits as a result of aging or other factors can be compensated for merely by adjusting the bridge drive to restore the reference value. Hence, the original calibration curves remain permanently applicable without the need for correction factors.

Circuit Description

The electronic circuitry employed in the complete integrometer is represented schematically in Figs. 3, 4, and 5. The Wheatstone bridge is energized from an a-c source to avoid the instability problems inherent in d-c amplifiers. The varying force at the adherometer cutting head causes the resistance of the strain gages to vary and results in a correspondingly varying bridge unbalance that modulates the 5-kc carrier supplied to the bridge by the oscillator and bridge drive circuit (Fig. 3).

The 5-kc excitation voltage is generated by a modified Wien bridge oscillator This is followed by two voltage amplifiers and a cathode follower power output stage. Negative feedback is taken from the cathode follower around the voltage amplifiers to increase stability.

The bridge output is fed to a high gain amplifier (Fig. 4) which is stabilized by two separate negative feedback loops. A range switch inserted between the two feedback chains permits selection of three different gain levels that cover the entire working range of stripping force likely to be encountered. A separate calibration curve is obtained for each of the three ranges.

The amplified signal is rectified by a diode detector and then integrated across a resistor-capacitor network having a time constant of 250 sec as compared with 17 sec for a stripping run, so that the voltage build-up across the integrating network is practically linear with applied voltage. The increase in potential across the integrating capacitor is impressed upon the grid of a balanced d-c amplifier as indicated in the meter circuit of Fig. 4. A conventional recorder connected between the cathodes of the d-c amplifier provides a record of the unbalance voltage introduced. A vacuum-tube voltmeter may be used instead of the recorder to measure directly the instantaneous voltage across the integrator and the final peak voltage representing the average value for the time interval under consideration; in this case, the 6SN7 d-c amplifier would not be needed.

A cathode follower, the 6J6 circuit in Fig. 4, is used to drive a milliammeter which provides, by appropriate switching, a visual indication of the null point of the bridge, the bridge driving voltage, and a reference voltage derived from a standard bridge unbalance.

The power supply (Fig. 5) is a conventional electronically regulated source that helps maintain the over-all stability of the equipment.

Automatic Operation

Operation of the adherometer-integrometer equipment has been simplified and the precision improved by the addition of a motor-driven 3-cam switching system (*11*, Fig. 1) which at the push of a button automatically performs all five of the electronic switching operations involved in an integrated stripping run. These operations include: (1) an initial 5-sec delay to allow the stripping action to stabilize before integration begins, (2) timing the stripping run and integrating process for a precise 17 sec, (3) allowing a 4-sec delay for the recorder to catch up with the integrator, (4) short-circuiting the integrating network to discharge it prior to the next run, and (5) shutting off the motor to stop all cams until the starting button is pressed again for a subsequent run.

A close-up photograph of the automatic switching equipment is shown in Fig. 6. The motor-driven cams actuate microswitches that control the various electronic circuits.

Calibration

The objective of the calibration procedure is to determine the readings yielded by the recorder, at each of the integrometer's three available sensitivity ranges, when various known loads are applied to the aluminum alloy beam for the precise period of time corre-

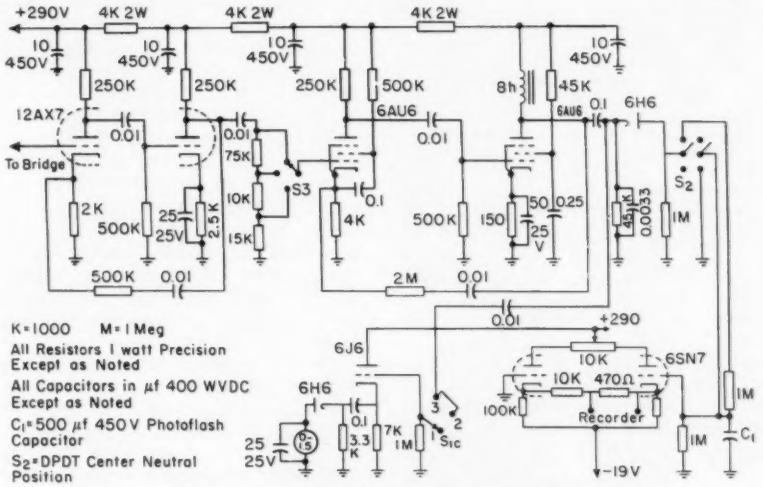


Fig. 4.—Amplifier, integrator, and meter circuit.

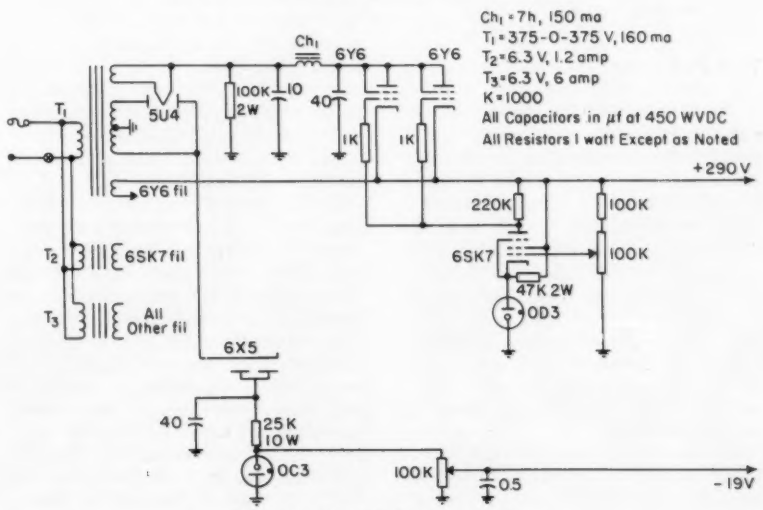


Fig. 5.—Regulated power supply.

sponding to an adherometer stripping run. The basic procedure is as follows:

Step 1.—Adjust the bridge drive oscillator for maximum undistorted (sine wave) output.

Step 2.—Detach the beam and strain gage assembly from the adherometer and clamp it in a manner that allows the beam to project horizontally beyond the edge of the workbench, so that weights may be suspended freely from the beam. The beam assembly remains electrically connected to the integrometer input.

Step 3.—Balance the bridge for zero or minimum output.

Step 4.—Bring the recorder pen to its arbitrary "zero" or starting position by adjusting the recorder zeroing control.

Step 5.—Adjust the bridge drive control to yield a suitable degree of recorder scale deflection for the various sensitivity ranges. The integrometer is designed to handle average loads up to 1 kg in the low or most sensitive range, 4 kg in the medium range, and 7 kg in the high or least sensitive range. Load peaks up to 1.5 times greater than these nominal ranges can be handled without introducing serious distortion into the amplifier circuits.

Step 6.—Determine the integrated value yielded by a standard unbalance in the bridge circuit. The milliammeter and recorder readings thus obtained constitute standard reference values against which the over-all operation of the equipment can be checked at any time to assure proper functioning of the various circuits. Drift from these reference values can be compensated, over a considerable range, by readjusting the bridge drive control.

Step 7.—Determine, at each sensitivity range, the integrated values obtained when a series of known loads are applied to the beam for the standard time interval (see step 2).

Step 8.—Plot the recorder readings as a function of load at each sensitivity range to obtain calibration curves from which the average force values corresponding to any given recorder reading can be read directly. The calibration curves remain permanently applicable without the need for correction factors provided that the equipment is always adjusted to give the standard reference value determined in step 6.

Test Procedure

The testing of specimens on the adherometer-integrometer equipment is rapid and simple because of the automatic control of the various electronic operations that is provided. Precaution must be taken, however, to properly "zero" the equipment before each stripping run. Also, the over-all operation of the equipment should be checked at frequent intervals by making a run with the calibrate resistor (standard unbalance) switched into the bridge circuit, and adjusting the bridge drive as may be required to restore the original calibration value.

To test a specimen, the coated test panel is clamped on the adherometer mounting plate and the weighted knife brought into contact with the panel and

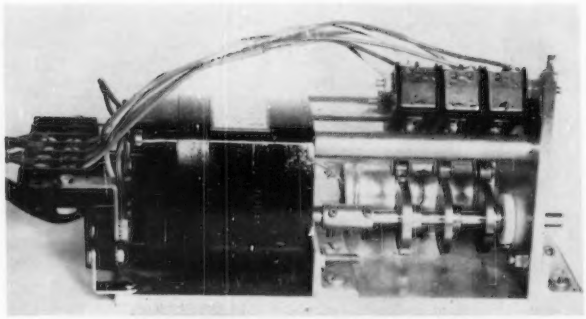


Fig. 6.—Close-up of motor-driven switch-cam assembly for automatic control of timing and integrating operations.

coating in the usual manner, with the usual precautions as to sharpness and orientation of the knife-edge (5). The integrometer range switch is set for the desired sensitivity. The starting switch on the adherometer proper is thrown "on" to cause the mounted specimen to be drawn along under the weighted knife; at the same time, the starting button on the integrometer is pressed momentarily to invoke the automatic sequence of electronic integrating operations. At the end of the automatically timed stripping run, the reading on the recorder chart is noted. Chart readings are converted to stripping force units by reference to the appropriate calibration curve.

The test specimens for which data are reported herein were evaluated both by the integrometer method and with the conventional adherometer ("pendulum and dial gage" method), so that a direct comparison of the new and old methods could be made. A steel knife was employed in the adherometer cutting head. The technique of precutting (3) the edges of the coating strip to be removed was not used except in the case of a few materials that could not otherwise be stripped cleanly. Since the primary objective of the present tests was to compare the pendulum and integrometer methods, the coatings were tested, in most instances, at only a single thickness, and the usual extrapolation technique for resolving adherometer stripping force values into adhesion and "plastic resistance" components was not employed; nor were friction or edge resistance determined.

Among the coatings tested were several vinyl resin types, a polysulfide polymer, a neoprene, an acrylic resin material, an alkyd-cellulosic lacquer, and a nitrocellulose-alkyd lacquer. These coatings were applied to primer-coated anodized aluminum alloy panels. Three replicate adherometer stripping runs were made by each of the two methods on each coated panel, except in a few cases as shown in Table I. In all cases the coating was removed down to the bare metal. The data given in Table I are intended as a direct comparison of the integrometer and pendulum methods rather than as a comparison of coating materials, since coating thickness and knife load were not the same for all materials. The stripping force values reported for the pendulum method are the average of as many gage readings (usually twelve) as could be written down during the stripping interval. This latter technique, though laborious, favors the obtaining of a fairly accurate average value for a given strip, despite the wide range of the individual readings. The data of Table I are summarized and analyzed in Table II.

Discussion

An indication of the wide range over which dial gage readings may vary during a single adherometer stripping run using the conventional pendulum method is given by the data in Table I. The range given is that encompassed by the twelve individual dial gage readings visually recorded during a particular stripping run. The average range of the stripping force corresponding to these twelve gage readings, for the 31 stripping runs, is 880 g. This corresponds to a standard deviation of approximately 270 g (computed by the range method), or a coefficient of variation of 7.6 per cent based on an average stripping force of 3547 g. (The standard deviation, σ, or the coefficient of variation expresses the range of the deviation on either side of the mean within which two-thirds of any group of observed values may be expected to fall. Ninety-five per cent of the observed values would be expected to fall within the

range of $\pm 2\sigma$, and practically all values would fall within the range of $\pm 3\sigma$.) In some instances, however, the variability along a single strip may be much greater than that predicted from the average case cited above. Thus, the 90–205 gage range specified for strip 1 on panel A corresponds to a range in stripping force of 2178 g. In this instance, the standard deviation of the twelve readings was approximately 668 g, corresponding to a coefficient of variation of 18.8 per cent; and the maximum deviation from the mean was over 30 per cent.

The variability among average values for different strips on the same test panel, as distinguished from the variability within a single strip, is given in Table II for each material tested by each method. The average values of the standard deviations for all eleven of the coated panels tested correspond to coefficient of variation of 4.1 per cent for the pendulum method and a coefficient of variation of 2.2 per cent for the integrometer method. Thus, the conventional pendulum method, even under the highly favorable averaging procedures employed, has a variability significantly greater than that of the new integrometer method.

Despite the high inherent variability of the pendulum method, the technique of obtaining a large number of individual readings per strip to give an average value for that strip, followed by an averaging of the values for several different strips, yields final values for a particular coating system that may not differ greatly (Table II) from those obtained by the inherently much more precise integrometer method. This technique of multiple visual readings per strip is very laborious, however, and subject to considerable personal error. Also, in the case of specimens much more variable than those for which data are reported here (and highly variable systems are often encountered), the increased personal error multiplied by pendulum momentum and inertia effects may yield very erroneous results even with the multiple reading technique. This is apparent from the relatively wide range of the coefficients of variation (Table II) for the eleven individual panels tested by the pendulum method as compared with the much smaller range of the coefficients for the same panels tested by the integrometer method; the precision of the pendulum method becomes poorer as the variability of the coating system under test becomes greater.

In contrast to the laborious methods and uncertain results involved in the pendulum method, the newly developed NBS integrometer method yields a comparatively precise average value with push-button ease. Since the integrator, in effect, yields the average of an infinite number of individual observations along a strip, the results obtained are essentially independent of the variability of the test specimen itself. The strain and personal error involved in the visual observation of varying gage readings are eliminated. The stripping action itself is accomplished with greater ease and uniformity because of the great reduction in the momentum and inertia effects associated with pendulum operation.

The foregoing conclusions as to the relative precision of the pendulum and the integrometer methods are borne out by a statistical analysis of the data. According to statistical theory, the various estimates of the standard deviation that are obtained for different samples from a single population will themselves have a standard deviation that bears a constant ratio to the standard deviation of the population. This is expressed by the theoretical equation in Table II. The value of the ratio depends on the number of values entering into each individual estimate of the standard deviation. For two degrees of freedom, as in the case of the present data, the theoretical value of the ratio is 0.50. It is seen that the value of 0.74 for s_s/s for the pendulum method is considerably greater than this expected value, indicating that the standard deviations of pendulum force values for the different materials very probably do not constitute a homogeneous population. The value of 0.39 for $s_s/\bar{s}$ for the integrometer method, on the other hand, is lower than the expected value, indicating that the standard deviations of integrometer force values can be considered to constitute a homogeneous population.

The practical significance of these tests of homogeneity is to demonstrate the existence of a variability factor in the pendulum method that is not present in the integrometer method. This additional variability appears from material to material in the pendulum method and is superposed on the normal instrument error. It results from the variable visual error and the variable momentum and inertia effects associated with different materials tested by the pendulum method. The absence of this additional variability in the integrometer indicates that it is subject only to ordinary instru-

TABLE I.—COMPARISON OF ADHEROMETER VALUES[a] FOR COATED PANEL AS OBTAINED BY THE PENDULUM AND INTEGROMETER METHODS.

Panel	Type of Topcoat	Strip	Pendulum Method		Integrometer Method, Average Force, g
			Gage Range	Average Force,[b] g	
A....	Vinyl resin	No. 1	90–205	3498	2475
		No. 2	90–160	2857	2650
		No. 3	100–160	2919	2580
B....	Vinyl resin	No. 1	90–150	2787	2720
		No. 2	85–155	2852	2830
		No. 3	90–130	2810	...
C....	Vinyl resin	No. 1	220–236	4697	4740
		No. 2	210–242	4725	4825
		No. 3	245–258	4924	4850
D...	Vinyl resin	No. 1	148–160	3536	3610
		No. 2	147–163	3547	3525
		No. 3	144–162	3522	3525
E[c]...	Polysulfide rubber	No. 1	57–90	2018	1623
		No. 2	60–120	2206	1753
		No. 3	52–90	1810	1753
F[c]...	Neoprene	No. 1	50–96	2887	2843
		No. 2	80–100	2929	2600
		No. 3	93–100	2960	2760
G....	Acrylic resin	No. 1	200–205	4467	5000
		No. 2	170–207	4254	5150
		No. 3	.....	...	4975
H[c]...	Alkyd-cellulosic	No. 1	110–170	4356	4320
		No. 2	130–180	4350	4375
		No. 3	125–165	4201	4250
I....	Alkyd-cellulosic	No. 1	190–240	4347	3975
		No. 2	140–240	4200	4025
		No. 3	.....	...	4025
J....	Nitrocellulose-alkyd	No. 1	70–125	2696	2860
		No. 2	130–155	3275	2760
		No. 3	100–160	2987	2760
K...	Nitrocellulose-alkyd	No. 1	125–200	3742	3500
		No. 2	150–230	3912	3720
		No. 3	160–230	4144	3525

[a] The data are intended as a comparison of methods only, not materials, since coating thickness and knife load were not the same for all materials.
[b] Each value is the average obtained from approximately 12 dial gage readings per strip.
[c] Precut specimen; edge resistance not present in force measured.

ment error which does not vary significantly from one material to another.

Finally, the data for the two methods were subjected to a Bartlett test (6) for homogeneity of variances. The computed χ^2 values shown in Table II show that the variances of the pendulum average values differ significantly among themselves at a 5 per cent level of significance, whereas the variances of the integrometer values do not differ significantly. This confirms the conclusion, reached above in a less rigorous manner, that the precision of the pendulum method varies from material to material whereas the precision of the integrometer method is essentially independent of the material tested.

The practical upper force limit for the pendulum method is approximately 5000 g, and the accuracy of the conversion from dial gage readings to horizontal displacement or force values decreases with increasing force because of the sine function relationship between angular displacement of the pendulum and force. The beam and strain gage assembly employed in the integrometer method more than doubles the upper available force limit. Although the high-range scale of the integrometer is nominally designated as a 7-kg range, the equipment will handle peak loads as high as 10.5 kg without significant deviation from linearity.

TABLE II.—STATISTICAL ANALYSIS OF DATA IN TABLE I.[a]

Pendulum Method				Integrometer Method			
Panel	Average Force, g	Standard Deviation,[b] s	Coefficient of Variation, per cent	Panel	Average Force, g	Standard Deviation,[b] s	Coefficient of Variation, per cent
E	2011	198	9.8	E	1710	75	4.4
B	2816	33	1.2	A	2568	88	3.4
F	2925	37	1.3	F	2734	124	4.5
J	2986	290	9.7	B	2775	78	2.8
A	3091	346	11.2	J	2787	55	2.0
D	3535	13	0.4	D	3553	49	1.4
K	3933	202	5.2	K	3582	120	3.4
I	4274	104	2.4	I	4008	29	0.7
H	4302	88	2.1	H	4315	63	1.5
G	4361	153	3.5	C	4805	58	1.2
C	4782	124	2.6	G	5042	95	1.9
Average	3547	144	4.1	Average	3444	76	2.2

$s_s = 107$ $\qquad$ $s_s = 29.4$

$\frac{s_s}{\bar{s}} = 0.74$ $\qquad$ $\frac{s_s}{\bar{s}} = 0.39$

$\frac{\sigma_s}{\sigma}$ (theoretical) $= \frac{1}{\sqrt{2n}}$, where n = degrees of freedom for each estimate of σ

For $n = 2$, $\frac{\sigma_s}{\sigma} = 0.50$

Bartlett Test:

χ^2 (pendulum) $= 20.08$ $\qquad$ χ^2 (integrometer) $= 6.14$

χ^2 (critical value from tables, ref. 6) $= 18.31$ (5 per cent level)

[a] The data are arranged to show the behavior of the standard deviation with increasing value of the stripping force.

[b] s is the symbol for the estimate of the standard deviation of strip averages obtained for each individual material. s_s is the computed standard deviation of the various values of s, or the estimated standard deviation of the standard deviations; σ_s is the true or theoretical standard deviation of the various values of s; σ is the true standard deviation for the entire population under consideration. All standard deviations were computed by the usual statistical formula:

$$s = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/N}{N - 1}}$$

where each individual value is denoted by x, and N is the number of replicates.

Summary

An improved adherometer is described in which the pendulum conventionally employed as a source of the stripping force needed at the cutting head is replaced with a beam and strain gage assembly whose output is fed to a specially designed electronic integrating device that yields an average value of the variable stripping force usually encountered in operation of the Interchemical adherometer. The integrometer output can be read on a voltmeter or fed to a conventional recorder. Voltages or chart readings are converted to force values by reference to a calibration curve.

Precise timing of the stripping run and the various electronic switching operations that enter into the integration process are performed automatically at the push of a button. The strain and error involved in the visual observation of varying gage readings are eliminated. The stripping action itself is accomplished with greater ease and uniformity because of the great reduction in the momentum and inertia effects associated with the pendulum method. The upper limit of available stripping force is more than twice that of the conventional adherometer.

Tests with eleven different coatings yielded an average coefficient of variation of 4.1 per cent for the pendulum method and 2.2 per cent for the integrometer method. Thus, the conventional adherometer, even under the highly favorable averaging procedures employed herein, exhibited a variability significantly greater than that of the new integrometer method. With more highly variable coating systems, the precision of the conventional adherometer would be expected to suffer accordingly, whereas the precision of the new integrometer method would remain essentially unchanged.

Acknowledgment:

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(6) O. L. Davies, "Statistical Methods," Oliver and Boyd, London, p. 113 (1947).

The Systematic Analysis of

Deposits from Oil-Fired Furnaces

By JAMES W. McCOY

These analyses, useful in current research in the development of fuel-oil additives, provide for determination of eleven metallic elements with less than 2 g of extracted residue

DURING the past few years several papers have been published (1, 2, 3)[1] dealing with the important problem of slag and deposit formation in furnaces fired with residual fuel oil. These are caused by metallic elements originally present in crude oil or introduced as contaminants during refining. Elements commonly present (2, 3) and for which determinations are described in this system include iron, aluminum, vanadium, lead, nickel, calcium, magnesium, sodium, silicon, sulfur, and carbon.

Furnace deposits often occur in layers of varying composition (2), and it is sometimes advisable to analyze them individually, in which case they must be separated by hand. Since this is a laborious operation it is advantageous to keep sample sizes to a minimum. The system described here provides for the determination of the above eleven elements using less than 2 g of extracted residue. Sodium and sulfur are determined using one portion, carbon using a second, and the remainder of the elements using a third 0.5-g portion.

The principal difficulty in handling these deposits is the preparation of the solution for analysis. Samples containing free carbon, incompletely burned fuel oil, and sulfonated products are difficult to oxidize, and some of the strongly ignited oxides and sulfates are very insoluble. Procedure B1, described below, although time consuming, is extremely effective for bringing these deposits into solution; the first residue seldom exceeds 20 mg.

No attempt has been made to identify the compounds actually present in the sample, nor does there seem to be any need to do so. The total amount of each element is reported as the oxide. Reference to Table I where the results of two separate analyses of each of four deposits are tabulated will give an indication of the reproducibility to be expected.

TABLE I.—TABULATION OF DUPLICATE ANALYSES OF FOUR DEPOSITS.

Source	Radiant Section		Superheater		Roof Tubes		Convection Bank	
Benzene extracted[a]	Nil		6.1		0.8		12.1	
Residue[a]	100		93.9		99.2		87.9	
Acid insoluble	4.3	4.2	1.7	1.2	1.7	1.8	1.1	0.9
Residue after HF	0.5	0.5	1.5	0.3	0.8	0.9	0.6	0.3
SiO_2	3.8	3.7	0.2	0.4	0.9	0.9	0.5	0.6
Fe_2O_3	10.4	10.5	60.9	60.6	24.0	24.5	69.5	68.0
V_2O_5	11.8	10.6[b]	2.6	2.5	Tr	Tr	1.6	1.8
Al_2O_3	3.1	3.2	2.3	2.1	1.8	1.5	0.8	0.3
PbO	Tr	Tr	Tr	Tr	23.6	25.2	1.4	1.7
NiO	13.8	13.0	Nil	Nil	4.6	4.0	0.3	0.3
CaO	4.1	3.8	1.4	1.2	3.5	2.8	2.0	1.5
MgO	2.4	3.0	0.7	0.9	1.2	1.7	1.2	1.2
Na_2O	13.2	13.3	Nil	Nil	8.3	8.4	0.3	0.2
SO_3	30.1	30.3	Nil	Nil	20.9	20.8	4.7	4.4
C[c]	Nil		30.5		2.8		11.8	

[a] These results are on an as received basis; the others are based on the extracted residues. A single portion of each deposit was extracted.
[b] A third determination gave a value of 11.1.
[c] A single carbon determination was made on each sample of extracted residue.

Preliminary Treatment of the Laboratory Sample

Furnace deposits occur in various forms and the preliminary treatment will depend upon its condition. Water is seldom present in any significant amount, and it is usually unnecessary to dry the sample. Multi-layered slags must be separated by hand if it is desired to determine the composition of each layer. Scales or slags from the radiant and superheater sections of furnaces are ordinarily free of carbon and may be treated directly by procedures B1 to B8 and C1 and C2. Samples containing carbon should be extracted with benzene as described in procedure A, since free carbon adsorbs other organic material which increases the difficulty of oxidation in procedure B1. Much of this material can be removed by a prolonged extraction with benzene. The amount extracted can be measured approximately by weighing the extraction thimble before and after the benzene treatment.

PROCEDURE A

Mix the submitted sample thoroughly, and weigh a representative 10-g portion into a Soxhlet extraction thimble of suitable size. Weigh the thimble and sample, place in a Soxhlet extractor, add 200 ml. of benzene to the flask, and reflux for approximately 1 hr, or until the refluxing benzene is colorless.

Cool the apparatus, remove the thimble, and place it in a beaker on a steam plate until the odor of benzene is no longer detectable. Dry briefly in an oven, re-

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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

weigh the thimble and sample, and calculate the loss in weight as benzene soluble. Transfer the residue to a mortar and grind it to a fine powder. Portions of this material are used for the determinations described in procedures B1 to B8 and C1 and C2. (Note).

NOTE.—The percentages of elements found in the B and C procedures are calculated on the basis of the extracted residue and not on the original sample.

Analysis of Extracted Residue

Preparation of Solution for Analysis

Furnace deposits are usually brought into solution by fusion with sodium or potassium carbonate. The fusion must be made in porcelain because of the possible presence of lead, and contaminants are always introduced. Because many of these deposits contain carbon, much spattering and frothing takes place resulting in losses. When samples are handled containing high percentages of carbon it becomes extremely difficult to obtain complete oxidation without loss. It is therefore desirable to prepare the solution by the wet method.

Although the use of sulfuric acid leads to the formation of a number of compounds that are difficult to get into solution, the high temperature is most effective for the oxidation of carbonaceous material. Perchloric acid alone is not satisfactory, for samples containing free carbon often have adsorbed organic material, probably heavy sulfonic acids, which are not removed completely by the benzene extraction. If such samples are fumed gently with perchloric acid, this material is rendered soluble, producing strongly colored solutions, usually deep orange, red, or green, and rather soapy and prone to foam. If, however, the solution is heated strongly, violent flashing or an explosion may occur.

In the procedure finally adopted, the sample is first fumed strongly with sulfuric acid to char organic material and prevent foaming after which nitric acid is added to oxidize as much organic matter as possible. Perchloric acid is next used to clear the solution of the last traces of carbon and the solution is evaporated to dryness. This leads to the formation of anhydrous sulfates of calcium, aluminum, lead, and nickel, a basic sulfate of iron, and an insoluble acid sulfate of trivalent chromium, $Cr_4H_2(SO_4)_7$, if this metal is present, which are troublesome to redissolve by ordinary methods. All of these are readily dissolved by treatment with hydriodic acid, through reduction of the sulfates to hydrogen sulfide in the acid solution (4). After two evaporations, the resulting iodides are oxidized with nitric acid. When this action is complete, the solution is cleared of nitric acid by fuming with perchloric acid. This has the additional advantage of producing a less contaminated silica residue than do the other acids. Finally hydrochloric acid is added to dissolve V_2O_5 which would separate if the perchloric acid were diluted with water. Several other substances, if present, would also separate including manganese dioxide, lead chromate, and lead vanadate. All of these remain in solution in the hydrochloric acid.

PROCEDURE B1

To a 0.5-g portion of the extracted residue from procedure A add 10 ml of concentrated H_2SO_4 and heat to fumes on a hot plate. After fuming strongly for a few minutes carefully add HNO_3 dropwise down the side of the beaker, continuing until a relatively clear solution is obtained. Cool the solution until only light fumes are being evolved and add about 10 ml of 30 per cent H_2O_2. As the solution fumes organic material which has distilled and condensed on the cover glass is washed back into the beaker by the refluxing acid and the solution darkens. It is advantageous to add hydrogen peroxide as soon as a relatively clear solution has been obtained with nitric acid. The peroxide distilling out of the hot sulfuric acid wets the organic matter on the walls and cover of the beaker better than does nitric acid and the solution is less likely to darken again as it concentrates. Return the beaker to the heat and fume again, adding more HNO_3, if the solution darkens. When a clear solution has been obtained, cool until fuming ceases, add 5 ml of HNO_3, 2 to 3 ml of $HClO_4$, return to the heat and evaporate to dryness. The presence of vanadium is indicated by a yellow to orange solution with nitric acid, turning green after a transient brown coloration (pervanadic acid) with peroxide, and finally becoming deep orange with perchloric acid. These changes may be masked if large amounts of nickel are present.

Allow the beaker to cool, add 5 ml of concentrated HI and evaporate to dryness on a steam plate. Repeat this treatment, cool, add 10 ml of HNO_3, and heat until no more iodine is evolved. Add 3 ml of $HClO_4$ and heat until this acid fumes. A few deposits have been encountered containing potassium in significant amounts. A fairly bulky precipitate of potassium perchlorate separates at this point if potassium is present. It can be determined later in an aliquot of the solution prepared in procedure C1 if desired.

Determination of Silica

Silica is determined as usual by volatilization with excess hydrofluoric acid using a single dehydration. Unlike internal boiler deposits, silica is not a major component of furnace deposits, the acid insoluble residue seldom exceeds 20 mg and usually is less. Silicates unattacked by hydrofluoric acid are rarely found in furnaces and no provision has been made for the analysis of the hydrofluoric acid residue. It ordinarily consists of iron and aluminum oxides with occasional small amounts of chromic oxide; its analysis is not usually significant. A small amount of manganese (less than 1 mg) is always to be expected and in the exceptional case where a large amount of silica is present, 1 mg or so of vanadic oxide may be retained in the residue; these may be disregarded. If the analysis of this residue seems desirable reference should be made to a previous paper (5) for details.

PROCEDURE B2

Transfer the residue and filter paper from procedure B1 to a tared platinum crucible and heat on a hot plate until the paper has dried and charred slightly. Smoke off the paper by heating in a radiator, and then ignite in a muffle furnace at 1100 C for 30 min. Cool the crucible in a desiccator, and weigh.

Add 1 to 2 ml of 1:1 H_2SO_4 to the residue and then about 5 ml of 48 per cent HF. Evaporate first on a steam plate, then on a hot plate; finally muffle at 1100 C for 30 min. Cool in a desiccator, and reweigh, recording the loss in weight as SiO_2. Discard the residue (Note).

NOTE.—If the weight of the residue does not exceed 5 mg it can usually be neglected. Should a larger residue be obtained it may be examined for iron and aluminum, these being the most likely metals to be found. The appearance of the residue will suggest the appropriate course to follow; it is best dissolved by carbonate fusion.

Determination of Iron and Vanadium

Iron and vanadium are precipitated from the filtrate obtained in procedure B1 by the addition of a solution of cupferron, ammonium N-nitroso-N-phenylhydroxylamine. This procedure produces a clean separation of these two metals from all others in the solution with the exception of lead. If the amount of lead exceeds 25 mg, lead chloride separates in the cold hydrochloric acid solution and is collected with the cupferrates; it is separated later in the procedure as lead sulfate and combined with that subsequently obtained in procedure B4. As a rule approximately one third of the total lead present falls with the cupferrates.

Iron and vanadium are often the principal metallic components of furnace deposits and their precipitation as cupferrates produces a conveniently compact precipitate even with 200 to 300 mg of the metals. Although the initial precipitate is voluminous it changes to a compact form upon standing which is easily filtered and washed. Furthermore, after oxidation of the precipitate both metals can be determined in the same solution without further separation.

When precipitation is complete the precipitate is filtered and washed. The cupferrates are then oxidized with nitric acid in a sulfuric acid solution. If any lead sulfate is present it is filtered

off and the filtrate is poured through a Jones reductor, the effluent being collected in a mixture of phosphoric acid and ferric ammonium sulfate. Iron is reduced to the ferrous state and vanadium to the bivalent ion according to the following equations:

$$2Fe^{+++} + Zn = 2Fe^{++} + Zn^{++} \quad (1)$$

$$16H^{+} + 2VO_4^{---} + 3Zn = 2V^{++} + 3Zn^{++} + 8H_2O \quad (2)$$

The effluent is titrated with standard permanganate to determine the total reducing equivalents. The reaction between vanadyl ion and permanganate is slow near the end point and care must be taken not to undertitrate. When all of the vanadium has been oxidized, an end point will be obtained which is stable for 1 min or more. The presence of vanadium is indicated by this slow end point and also by the blue color of the vanadyl ion in the receiver. It should be noted that the reduction products of nitric acid react slowly with permanganate in a manner similar to vanadyl ion. No confusion should result if vanadium were absent, since no blue color would be present and no permanganate would be consumed in the second titration. If vanadium were present, however, this source of error might be overlooked. The iron determination would of course be worthless in either case.

Vanadium alone is next determined by the method of Hamner (6). Ferrous sulfate is added to the solution in excess, reducing vanadate to the vanadyl state according to the equation:

$$6H^{+} + VO_4^{---} + Fe^{++} = VO^{++} + Fe^{+++} + 3H_2O \quad (3)$$

The excess ferrous ion is oxidized with ammonium persulfate which in the cold reacts but slowly with vanadyl ion and the solution is again titrated with standard permanganate. From the two titrations the percentages of iron and vanadium can be calculated.

PROCEDURE B3

Dilute the filtrate from procedure B1 to 200 ml, chill in an ice bath for a few minutes, and precipitate the metals with a cold 6 per cent aqueous solution of cupferron by slow dropwise addition with vigorous stirring. When precipitation is judged to be complete filter the precipitate on Whatman No. 40 paper, testing the first few milliliters of filtrate for completeness of precipitation. Completeness of precipitation may be judged by allowing the coagulated precipitate to settle and adding a drop of cupferron solution to the supernatant liquid. A white flash of the salt which immediately dissolves indicates that precipitation is complete. This test may fail in the presence of a large precipitate and the first portion of filtrate should always be tested with a few drops of the cupferron solution. A clear supernatant liquid without any milky appearance is obtained when the reagent is in excess. Wash the precipitate with a solution containing 2 ml of cupferron solution in 100 ml of 10 per cent HCl. Four 10-ml washes are sufficient.

To the filtrate add 10 ml of HNO_3 and evaporate to dryness. Reserve for treatment in procedure B4.

Transfer the paper and precipitate to the original beaker, cover with a ribbed watch glass and heat on a hot plate until the material is well charred and no further effervescence takes place. Cool the beaker, add 10 ml of sulfuric acid, and heat to fumes. Allow the solution to fume for a few minutes and then oxidize by careful dropwise addition of HNO_3. If sulfuric acid is added directly to the precipitate without a preliminary decomposition on the hot plate the solution will foam so excessively that it may overflow the beaker, in any case the oxidation will be unduly prolonged. Similarly, if the sulfuric acid is not fumed for a while after the initial heating, the solution will foam and spatter when the addition of nitric acid is begun. When a clear solution is obtained add 5 ml of HNO_3, 3 ml of $HClO_4$ and again heat to fumes of H_2SO_4, finally evaporating to a volume of approximately 5 ml (Note 1).

Cool the acid solution and add 100 ml of water. If a precipitate of $PbSO_4$ is present, chill the beaker in an ice bath for 30 min, then filter the solution through Whatman No. 40 paper washing with 2 per cent H_2SO_4. Reserve the paper and precipitate for combination with that obtained in procedure B4.

Dilute the filtrate to approximately 200 ml and pour through a Jones reductor, collecting the effluent under a mixture of 25 ml of 10 per cent ferric ammonium sulfate and 5 ml of phosphoric acid. Wash the column with water and titrate the contents of the receiver with 0.1 $KMnO_4$, continuing the titration until an end point is obtained which persists for 1 min.

Record the milliliters of permanganate consumed.

To the same solution add 20 ml of 0.1 ferrous ammonium sulfate and mix thoroughly by swirling. Add approximately 0.5 g of ammonium persulfate, swirl to dissolve, allow to stand 1 min, and titrate with $KMnO_4$ as before to a stable end point. Record the milliliters of permanganate consumed and discard the solution.

From the two titrations calculate the percentages of iron and vanadium in the sample (Note 2).

NOTE 1.—Perchloric acid is added here to clear the solution of nitric acid which would be reduced in the Jones reductor to hydroxylamine and other compounds which reduce permanganate.

NOTE 2.—The milliliters of permanganate consumed by ferrous iron is the first titration minus three times the second. The second titration gives the vanadium directly using an equivalent weight of 50.95.

Determination of Lead

Lead is removed from the evaporated filtrate obtained in procedure B3 by precipitation with hydrogen sulfide in dilute acid solution. The precipitate of lead sulfide is combined with any lead sulfate separated in procedure B3, the paper is destroyed by wet oxidation and lead sulfate is filtered and weighed.

PROCEDURE B4

To the evaporated cupferron filtrate add 3 ml of HCl and 100 ml of water and heat to boiling. When solution is complete bubble a stream of H_2S through the solution while allowing it to cool. After about 5 min add 100 ml of water and one drop of NH_4OH. Continue the stream of H_2S for another 5 min then set the solution aside on a steam plate until the precipitate coagulates.

When a clear solution is obtained filter the precipitated lead sulfide on Whatman No. 40 paper, washing with a slightly acid solution saturated with H_2S. Treat the filtrate by procedure B5.

Combine the precipitate and paper obtained here with any lead sulfate from procedure B3, add 10 ml of H_2SO_4 and 5 ml of HNO_3 and heat to fumes. The organic matter and sulfur must be oxidized completely by further dropwise addition of HNO_3 to the fuming sulfuric acid. The sulfur formed by the oxidation of sulfide may not be oxidized completely if a large amount is present. In this case it will fuse into a small bead which floats on the surface. It can easily be removed and discarded when the solution is diluted; the loss of lead by inclusion is negligible.

When a clear colorless solution is obtained cool, add 5 ml of 30 per cent H_2O_2, and evaporate to a volume of approximately 5 ml. Cool the solution to room temperature, carefully add 50 ml of water, chill in an ice bath for 5 min, add 50 ml of formula 30 alcohol and allow to stand for 30 min.

At the end of the standing period filter the solution through a tared sintered-glass crucible of medium porosity. Police the beaker and wash the precipitate with four 10-ml portions of a wash solution prepared by adding 5 ml of H_2SO_4 and 100 ml of formula 30 alcohol to 900 ml of water. Finally wash with four 10-ml portions of alcohol, place the crucible in an oven at 105 C for 30 min, cool in a desiccator, and reweigh. Discard the filtrate and washings.

Determination of Aluminum

The filtrate from procedure B4 is boiled to remove hydrogen sulfide, and aluminum is precipitated by the urea-basic succinate method of Willard and Tang (7). In this method the basic succinate of aluminum is precipitated by the hydrolysis of urea in a boiling solution. The ammonia precipitation is not satisfactory because of the serious coprecipitation of nickel (8), especially if an excess of ammonia is used.

With the basic succinate procedure several advantages are realized, a dense easily filterable precipitate is obtained; the slow hydrolysis of urea results in a gradual increase of pH in a homogeneous solution; a low final pH is obtained (4.2 to 4.6) resulting in cleaner separations from the bivalent elements.

PROCEDURE B5

Boil the filtrate from procedure B4 evaporating to about 200 ml to remove H_2S. Keeping the solution boiling carefully neutralize with NH_4OH until a faint permanent turbidity or opalescence is produced. Add 5 g of succinic acid and if the precipitate does not dissolve add HCl drop-

wise until a clear solution is obtained. This preliminary neutralization must be made carefully to avoid an excess of hydrochloric acid. Time should be allowed between drops and the solution kept boiling since the precipitate dissolves slowly.

To the boiling solution add 5 g of urea dissolved in a little water, place a small piece of filter paper under a stirring rod in the beaker to promote even boiling and boil gently for 90 min adding water from time to time so that the final volume is about 150 ml. To ensure complete precipitation of aluminum this boiling period should not be shortened.

At the end of the boiling period remove the beaker from the hot plate and filter the hot solution through Whatman No. 41 paper, washing with a 1 per cent solution of succinic acid neutralized to methyl red with ammonia. Treat the combined filtrate and washings by procedure B6.

A layer of basic succinate that usually adheres to the beaker is dissolved in 2 ml of HCl, diluted to 50 ml, heated to boiling, and neutralized to methyl red with NH_4OH. Allow 2 to 3 min for the precipitate to flocculate, and filter through Whatman No. 41 paper, washing with the same solution as above. Discard the filtrate and washings.

Combine the two filters containing the precipitates in a tared platinum crucible, dry, char, and ignite for 1 hr at 1100 C. Cool and reweigh, recording the weight of Al_2O_3 (Note).

NOTE.—Occasionally a small amount of chromium is present in furnace deposits imparting a green color to the aluminum oxide residue. Ordinarily the amount is too small to affect the result significantly.

Determination of Nickel

Nickel is precipitated from the aluminum filtrate by the dimethylglyoxime procedure. This method is so well known that no discussion is necessary; a single precipitation is sufficient.

PROCEDURE B6

To the combined filtrate and washings from procedure B5 having a volume of about 200 ml, add 5 ml of HCl and heat to 60 to 80 C. Add 5 ml of a 1 per cent alcoholic solution of dimethylglyoxime for every 10 mg of nickel estimated to be present (Note 1). Stir, and add NH_4OH dropwise to the solution until a permanent precipitate forms and then 2 to 3 drops in excess. A large excess of ammonia must be avoided or magnesium may be precipitated. Digest on the steam plate for 1 hr.

Cool to room temperature, let stand for 1 hr, and filter through a tared sintered-glass crucible of coarse porosity, washing with cold water. Dry in an oven at 110–120 C (Note 2) for 45 min, cool, and reweigh. The precipitate contains 20.31 per cent nickel. Treat the filtrate by procedure B7.

NOTE 1.—Usually 25 ml of reagent is sufficient for furnace deposits.

NOTE 2.—If more than 100 mg of precipitate is obtained, it is advisable to dry at 150 C to volatilize any coprecipitated reagent.

Determination of Calcium

The filtrate from procedure B6 is acidified and diluted to volume in a 250-ml volumetric flask. Calcium is double precipitated from an aliquot of this solution with ammonium oxalate and determined permanganimetrically.

PROCEDURE B7

To the filtrate from procedure B6 add 5 ml of HCl and evaporate to a volume of approximately 200 ml. Cool and dilute to volume in a 250-ml volumetric flask.

Transfer a 100-ml aliquot of the solution to a 250-ml beaker, add 25 ml of saturated ammonium oxalate solution, heat to 60 C (Note), and precipitate $CaC_2O_4 \cdot H_2O$ by dropwise addition of NH_4OH, continuing until methyl red indicator just turns yellow. Remove from the heat, cool to room temperature and filter through Whatman No. 40 paper washing beaker and precipitate with water.

Dissolve the precipitate in warm 1:1 HCl receiving the solution in the original beaker. Dilute to 100 ml and reprecipitate as above, filtering and washing as before. A significant amount of magnesium oxalate is always present in the first precipitate; the second precipitation should not be omitted.

Discard the filtrate and washings, place the original beaker under the funnel, fill the paper half full of water, punch a hole in the paper with a small stirring rod, and wash the precipitate into the beaker. Fold the washed paper over the side of the beaker, add 100 ml of water and 25 ml of 1:1 H_2SO_4, heat to about 80 C, and titrate with 0.1 *N* $KMnO_4$ to a stable end point. Push the paper into the solution, stir to disintegrate it, and complete the titration. Record the titration and normality of the permanganate, and calculate the percentage of calcium.

NOTE.—To minimize the coprecipitation of magnesium the solution should not be boiled nor should it be kept hot after the neutralization.

Determination of Magnesium

Magnesium is determined in an aliquot of the solution prepared in procedure B7 by the 8-hydroxyquinoline gravimetric method. A discussion of the application of this procedure to a similar solution has been given in a previous publication **(5)** and will not be repeated here. A double precipitation is required because of the high concentration of salts in the solution and not more than 150 mg of precipitate should be handled.

PROCEDURE B8

Transfer a 50-ml aliquot of the solution prepared in procedure B7 to a 400-ml beaker, dilute to 200 ml and heat to about 60 C. Add a few drops of phenolphthalein, 10 ml of a 5 per cent solution of 8-hydroxyquinoline (oxine) in 2*N* acetic acid and precipitate magnesium hydroxyquinolate by dropwise addition of NH_4OH, continuing until the indicator turns red. Set the solution aside for at least 2 hr and at the end of the standing period, filter through Whatman No. 7 paper, washing thoroughly with hot water.

Dissolve the precipitate in 20 ml of warm acetic acid, dilute to 200 ml, add 1 ml of oxine solution, and reprecipitate as above. After the 2-hr standing period filter on a tared coarse sintered-glass crucible (Note 1) and wash with hot water until no odor of oxine is detectable in the crucible. Discard the filtrate and washings of both precipitations.

Dry the crucible in an oven at 100–105 C or 130–140 C for at least 1 hr, cool, and weigh. Using the appropriate gravimetric factor (Note 2) calculate the percentage of magnesium oxide.

NOTE 1.—A coarse granular precipitate should be obtained. If it is flocculent another precipitation should be made.

NOTE 2.—The factor at 100 to 105 C for MgO is 0.1157, at 130 to 140 C it is 0.1291.

Determination of Other Components

In addition to the components previously covered, furnace deposits may contain carbon, sodium, and sulfate in significant amounts. A single portion of the extracted residue treated in procedure A is employed for the determination of sodium and sulfate. Carbon is best determined on another portion by a direct combustion method. Several models of combustion apparatus are commercially available and most industrial laboratories have one.

Determination of Sodium and Sulfate

Because of the method of preparing the solution for the determination of the metals by procedures B1 to B8, a separate sample must be used for sodium and sulfate. These two components are brought into solution by boiling a portion of the extracted residue with a solution of ammonium carbonate. Sodium in furnace deposits is usually in a readily soluble form and there is seldom any difficulty in obtaining complete recovery. Sulfate may be present in the form of anhydrous salts which are little affected by water alone. Anhydrous calcium sulfate and basic sulfates of iron and aluminum are particularly resistant to solution in water. These salts are all brought into solution by the metathesizing action of ammonium carbonate with the additional advantage that very little of the metallic constituents pass into the filtrate.

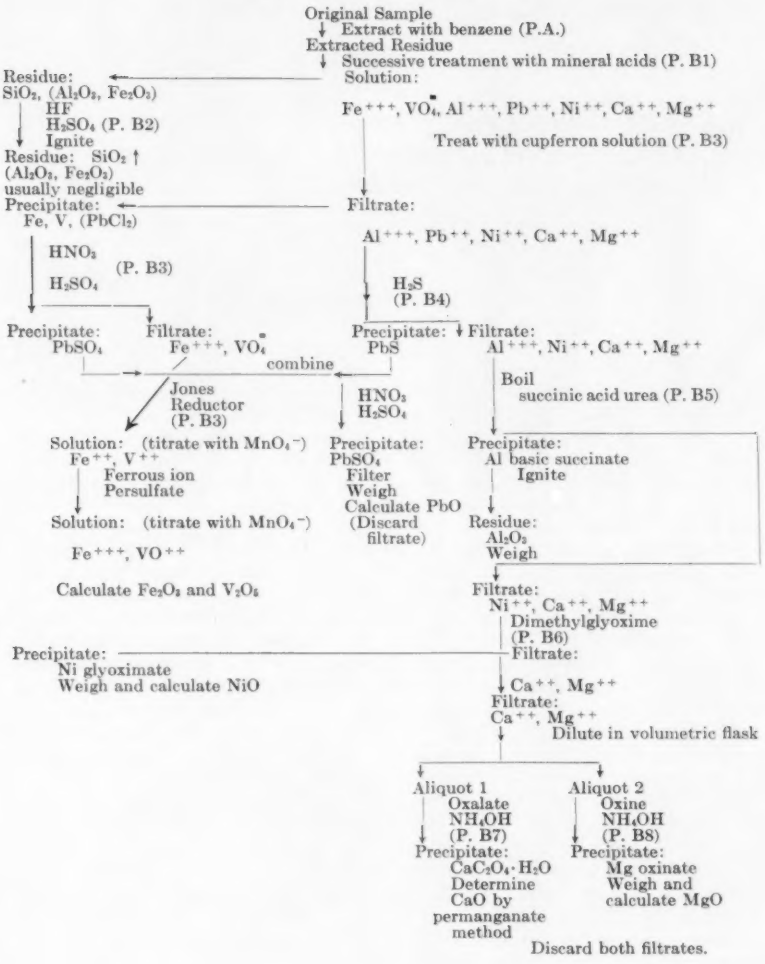
After filtration the solution is diluted in a volumetric flask and aliquots are used for the sodium and sulfate determinations. Sodium is precipitated and weighed as the triple salt of zinc uranyl acetate; the reagent and wash solution are prepared as described by Hillebrand and colleagues **(9)**. Sulfate is precipitated and weighed as barium sulfate.

PROCEDURE C1

Weigh a 1-g portion of the extracted residue from procedure A into a 250-ml beaker, add 100 ml of 5 per cent $(NH_4)_2CO_3$ solution, and boil for 15 min. Filter the hot solution through Whatman No. 42 paper receiving the filtrate in a 250-ml volumetric flask. Wash the residue with four or five 10-ml portions of 1 per cent $(NH_4)_2CO_3$ solution, cool the contents of the flask, and dilute to volume with water. Discard the residue.

Transfer a 25-ml aliquot to a 50-ml beaker, add 2 ml of HNO_3, and evaporate

SCHEME OF ANALYSIS



to dryness on a steam plate. Cool the beaker, moisten the residue with 1 ml of water, add 25 ml of zinc uranyl acetate reagent, and stir well. Allow the solution to stand 30 min, and filter through a sintered-glass filter crucible. Wash with four 10-ml portions of reagent and four 10-ml portions of alcohol wash solution; rinse three or four times with ether. Dry by suction, wipe the outside of the crucible, let stand 30 min, and weigh. Calculate the percentage of sodium, deducting a blank if necessary (Note), from the weight of sodium zinc uranyl acetate found.

NOTE.—The blank is usually less than 0.5 mg with quality reagents.

PROCEDURE C2

Transfer a 100-ml aliquot of the solution prepared in procedure C1 to a 400-ml beaker, dilute to 250 ml, and neutralize to methyl red with HCl adding 4 to 5 drops in excess. Heat to boiling and precipitate barium sulfate by dropwise addition of a 10 per cent solution of barium chloride. Digest the solution for 2 hr on a steam plate, and then cool to room temperature. Filter through Whatman No. 42 paper, wash with water, and ignite the paper and precipitate for 1 hr at 1100 C. From the weight of $BaSO_4$ obtained, calculate the percentage of sulfate in the sample.

Reporting of Results

An attempt has been made to provide a system for the determination of the chemical composition of deposits formed in oil-fired furnaces. This information is an important feature of research currently in progress (3) in the development of fuel oil additives to control deposit formation. Obvious advantages of a systematic approach are economy of time and consistency of results. An experienced analyst can complete the procedures in about 16 working hours.

In the following table results of two complete analyses on each of four different deposits are summarized to indicate the repeatability to be expected. All results are expressed as percentages.

In addition to the determinations described in the foregoing procedures others are sometimes made in special studies. These include stable and volatile sulfur trioxide, equivalent acidity, pH, and alkali-acid ratio. These are covered in one of the publications cited (3) and their variation with temperature conditions are described. Determinations of solubility in water and loss on ignition are sometimes made but the information is of no particular value and results are difficult to reproduce.

The form of the final report varies with the purpose of the analysis; a tabulation similar to that above is generally satisfactory.

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The Characterization of Pressure-Sensitive Adhesives*

By FRANK H. WETZEL

Quantitative methods for a study of factors affecting pressure-sensitive-adhesion—tack, yield stress, viscosity—can be utilized in studying the effects of plasticizers, fillers, and stabilizers

PRESSURE-sensitive adhesives are usually composed of a rubbery type polymer, a tackifier (usually a resin), and various plasticizers, fillers, or stabilizers. Adhesive systems other than pressure sensitive are sufficiently fluid when applied to effect intimate contact between adhesive mass and substrate (or adherend). Such contact is generally recognized to be necessarily on the molecular scale in order to bring into play the dispersion, residual valency or polar effects that are responsible for adhesion (1)[1]. In pressure-sensitive systems, the adhesive mass must wet the substrate and must deform at the interface to contact the adherend intimately. The latter effect requires a relatively low modulus of elasticity, as well as a short relaxation time in order to relieve internal stresses. However, the soft, rubbery systems which possess the properties necessary to effect the above are also susceptible to long-time viscous flow. Under static loads to which they are subjected in use, these adhesives flow sufficiently to cause bond failure ultimately.

The purpose of the present paper is to describe a new method of characterizing pressure-sensitive adhesives that makes possible a quantitative measurement of three important physical properties. These are: tack (also called quick-stick), internal strength, and viscosity.

Tack may be defined (2,3), for adhesive purposes, as the property of a material which enables it to form a bond of measurable strength immediately upon contact with another surface. For pressure-sensitive adhesives, further assumptions may be made: (1) Tack is a surface phenomenon and should be measured as such. It is not a direct function of internal strength, measurement of which is made by means of tensile determinations on free films. (2) The strength of a bond formed at the surface should develop shortly after contact between an adherend and adhesive surface. (3) When such a bond is broken, failure should be interfacial between adherend and adhesive. Tack should therefore be measured as the force required to separate an adherend and adhesive at the interface shortly after they have been brought rapidly into contact under light load of short duration.

Internal strength is measured by means of a tensile determination on free films of adhesive masses. Measurement of the cohesion of an adhesive is thus independent of a substrate.

Measurement of viscosity of rubbery elastomers of the type used in pressure-sensitive adhesives may be accomplished by several methods. These are constant stress elongation (4), constant load elongation (5), constant rate of elongation (6), and by means of the parallel plate plastometer (7). The first three methods yield complete characterization of a polymer in the elastic, plastic, and viscous region. For the present study, primary need was for viscous-flow data on the adhesive mass. The parallel plate plastometer of the du Pont-Williams type is best suited.

The determination of the deformability of the adhesive mass is currently under study. This will involve determination of a true modulus of elasticity at low elongations (less than 10 per cent) and at short times of deformation (less than 1 sec) by means of the application of small static loads and consequent measurement of deformation and recoverability.

Tack

Procedure

A polished, brass probe is held in a free sliding piston-type probe holder, which determines the load on the probe. This is shown in Fig. 1. The probe slides within an aluminum pipe which is rigidly attached to a load cell as pictured in Fig. 2. A pressure-sensitive adhesive film, supported on glass, approaches and makes contact with the probe at 20 in. per min. After a contact time between probe and film of 1 sec, the film moves away from the probe at 20 in. per min. The stress required to break the bond, recorded by means of the load cell and a high-speed recorder, is the tack. The time required to separate the probe and film is approximately 0.01 sec.

The same probe is used for five consecutive tack determinations. If tack readings become progressively higher, adhesive pickup on the probe is indicated. If strings of adhesive on the probe are visually observed or if microscopic (300×) examination of the probe surface shows the presence of adhesive, the data obtained are discarded. The requirement of true interfacial bond rupture for tack measurement is therefore checked on a microscopic scale. It is recognized that these breaks may not be interfacial on a molecular scale.

The precision of individual tack measurements is illustrated in Table I. Typical data on tackifier-rubber compositions involving two rosin esters show a range of variance of ± 10 per cent from an arithmetic average. Each number shown represents an average of ten individual tack determinations, which has been found to be statistically significant.

Tack values are reported as load in grams per $\frac{1}{16}$-in. diameter probe. A tack of 1200 g is equal to 860 psi. The values for these bond strengths are much greater than the tensile strengths for the adhesive mass (see Figs. 3 and 4). However, the tensile

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* This paper was presented at the Symposium on Rheology of the June, 1956 meeting of the Society of Rheology and the 59th Annual Meeting of ASTM.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

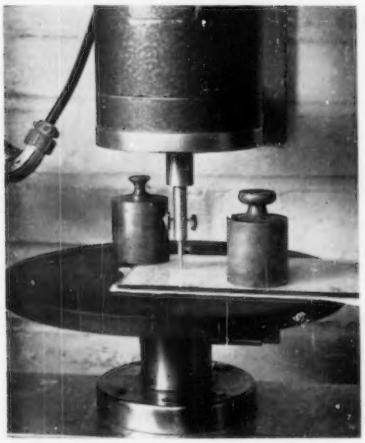

Fig. 1.—Probe in Holder, in Contact with Film.

Fig. 2.—Instron Machine and Sanborn Recorder Modified for Hercules Tack Test.

TABLE I.—TACK AS A FUNCTION OF ROSIN ESTER CONCENTRATION IN NATURAL RUBBER.

Composition	Tack, g per $\frac{1}{16}$-in. diameter probe[a]	
Parts Rosin Ester per Parts Rubber	Pentalyn A—Rubber	Poly-pale Ester 10—Rubber
1:3.....	295, 295, 275	265, 325, 200
1:2.....	315, 310, 280	265, 260, 270
2:3.....	450, 445, 455	350, 325, 325
1:1.....	955, 915, 930	460, 515, 525
3:2.....	1225, 1215, 1295	1155, 1155, 1065
2:1.....	610, 620	1220, 1330, 1240
3:1.....	0, 0, 0	150, 140, 150

[a] Each number represents an average of ten determinations per film.

strengths or yield stresses are calculated on the basis of load at yield per original cross-section of the specimen. The rate of testing of the two determinations is quite different. Even though the exact effect of the difference in rate cannot be defined, the higher rate used in the tack test would be expected to give much greater apparent strengths. Tension specimens are susceptible to stress concentration at flaws in the $\frac{1}{2}$-in. wide strips. Such phenomena would not be expected in the tack test.

Recorder

The high-speed recorder is a Sanborn, model 150 oscillographic recording system. This recorder has a response of 100 cps.

Probe Holder

A knurled screw in the holder allows a change of probes without disturbing either the load cell or probe holder. The probe holder, constructed of stainless steel to minimize wear, has been designed so that a load of 10 g is brought to bear on the $\frac{1}{16}$-in. diameter probe. This is equivalent to 7 psi. The probe holder is designed to give a maximum area of guide surface, and this surface is coated with graphite to reduce friction.

The crosshead of the Instron tension testing machine on which the film travels, and the probe are adjusted to an angle of 90 deg to each other, and thereafter the angle is checked regularly. This is necessary to insure constant area of contact.

Probes

The probes are brass rods $\frac{1}{16}$-in. diameter. The ends of the probes are machined 90 deg to the longitudinal axis, and then polished by means of standard metallographic techniques. Microscopic examination (300×) of the probe surface shows a smooth, unscratched surface, approximately square to the sides of the probe.

The probe material used at present is brass. Other probe materials such as aluminum, steel, and glass have been used. Although the absolute tack value does change with probe material, the relative order of tack of the series of adhesives tested does not. A study of tack as a function of probe material could lead to an insight into the nature of tack (8).

Rate of Crosshead Motion

The speed of 20 in. per min used for formation and separation of the probe-adhesive bond was selected because this rate causes bond failure to be interfacial. At rates lower than 20 in. per min, the adhesive has a tendency to leg or string. The stress required for this type of bond failure is a measure of flow or internal strength and is not a measure of the surface property defined as tack. Investigation of rates higher than 20 in. per min has not been made.

Contact Times

The length of time of contact between probe and adhesive is critical. Tack increased rather sharply and linearly as contact time increased from 0 to approximately 10 sec. Tack values increased less rapidly with contact times of from 10 to 20 sec and when contact times greater than 20 sec were used, the tack was constant. Since tack measurements are made in an extremely critical contact time region, the contact time of exactly 1 sec was meticulously observed to avoid this source of error.

Internal Strength

Because of the viscoelastic nature of unvulcanized natural rubber, all of the tackifying resin–rubber films pass through a yield point when subjected to elongation at a constant rate. At low rates of elongation this yield point is the maximum tensile strength exhibited by the specimen. It is possible to pull at a rate at which the specimen will, after having passed through a yield point, offer a pull resistance which is constant over a period of several hundred per cent elongation. If the rate of pull is increased, the specimen will pass through a yield point, reach a minimum, and then increase its resistance so that maximum tensile strength occurs at a

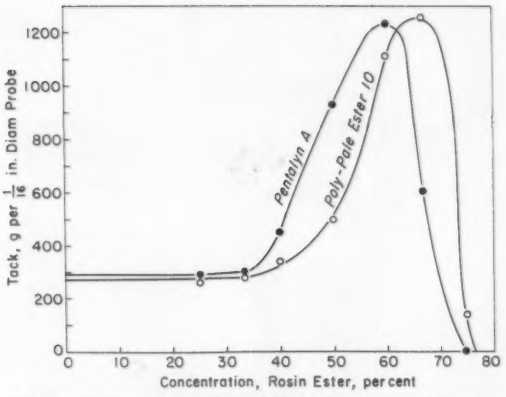

Fig. 3.—Tack as a Function of Tackifier Concentration in Rubber.

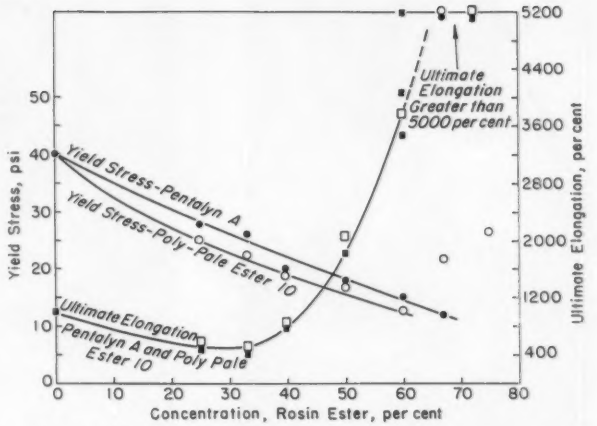

Fig. 4.—Yield Stress and Maximum Elongation as a Function of Tackifier Concentration in Rubber.

fracture of the specimen. Data obtained at 2000 per cent elongation per minute indicated that at this rate the yield point and tensile strength were identical. The yield point of the free films obtained at 2000 per cent elongation per minute, was chosen as the strength property most easily measured and compared.

Viscosity

The theory and application of the parallel plate plastometer in determining viscosities at low rates of shear has been described by Dienes and Klemm (7). The time-deformation curve which results from the use of the plastometer method has been described as a combination of elastic, delayed elastic, and viscous regions. The viscous portion of this curve is generally thought to be nonrecoverable and usually takes the form of a straight line of definite slope. Such a straight line was not obtained from data at room temperature until the determination had run for hours or even days. This indicated that at room temperature the behavior of the tackifier-rubber mass was either elastic or delayed elastic for some time. Determinations at 70 C indicated that the viscous region was reached in a matter of minutes. For this reason, determinations were carried out at 70 C. Relative differences in viscosity of various adhesive masses obtained at 70 C are very probably the same as those which would be obtained from long times of measurement at room temperature. Subsequent determinations will, however, be carried out at room temperature.

Preparation of Samples

Supported Films

Toluene solutions of the adhesive masses are cast on glass plates by means of a 16-mil doctor blade. A period of 16 to 24 hr is allowed to elapse before the film is solvent free and the tack of the supported film is tested. The thickness of the films is a function of the per cent solids of the solution. Wet films, 16 mils thick, from a solution containing about 25 per cent solids yield a dry film that is approximately 2.2 mils thick, as determined by differential microscopy. Extremely variable data are obtained when film thicknesses less than 1.5 mils are used. The latter thicknesses presumably show the contours and surface irregularities of the glass plates upon which the films are cast. Ordinarily, films of 2.0 to 2.5 mils are used. Use of thicker films has been found to have no effect.

Free Films

Free films, 20 mils thick, of adhesive mass were prepared by toluene-solution casting on amalgamated tin plate (4) or Teflon sheeting. The amount of drying required for the film to become solvent free was determined by (1) extraction of residual toluene from a weighed sample of film by *iso*octane and determination of toluene in the extractant by means of chromatography, or (2) extraction of toluene from a weighed sample by refluxing the sample in an ethanol-heptane azeotrope. The concentration of toluene is then determined by ultraviolet absorption of the extractant.

Study of Specific Adhesive Systems

The method for the characterization of pressure-sensitive adhesives was applied initially to a system consisting of pure, natural, unvulcanized rubber plus a tackifying resin, such as Polypale Ester 10 (a glycerol ester of dimerized rosin) or Pentalyn A (a pentaerythritol ester of wood rosin). Tack, internal strength, and viscosity were studied as a function of seven compositions for tackifier, ranging in amount from 25 to 75 per cent.

Typical data plotted in Fig. 3, show that tack increases above 40 per cent concentration of tackifying resin, achieves a maximum and then decreases rapidly when above approximately 70 per cent. The maximum in tack and manner of variation of tack with composition varies with the tackifier.

Legging has been occasionally observed at tackifier concentrations greater than 60 to 70 per cent. This may be defined as separation of small amounts of adhesive or actual strings of adhesive on the probe from the film during the bond rupture step. When legging occurs, the tack or adhesiveness of the surface has probably exceeded the internal strength or cohesiveness. Occurrence of this phenomenon makes the measurement of tack impossible under the conditions of the tack test. Practically, legging may mark the disappearance of useful tack when pressure-sensitive adhesives are used in applications in which the adhesive is required to strip cleanly from a surface.

The variation of tensile properties with tackifying resin concentration is illustrated graphically in Fig. 4. Tensile strength (yield stress) decreases with increasing tackifier concentration. The rate of decrease is different depending upon the tackifier involved. In the case of Poly-pale Ester 10, a slight in-

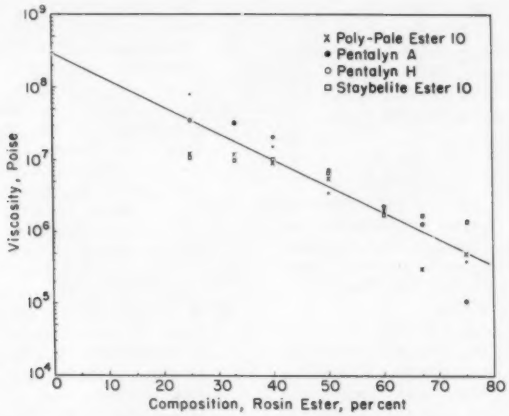

Fig. 5.—Viscosity at 70 C as a Function of Tackifier Concentration in Natural Rubber.

crease in tensile strength has been observed when its concentration is greater than 60 per cent. The ultimate elongation increases very rapidly as tackifying resin concentration increases from 50 to 75 per cent.

Viscosity at 70 C decreases from 3×10^8 poises for pure rubber to approximately 4×10^5 poises at a concentration of 75 per cent tackifying resin. The effect of concentration on viscosity is shown in Fig. 5. Scattering of the data is noted at concentrations of less than 40 per cent and greater than 70 per cent. At concentrations of less than 30 per cent, many of the delayed elastic mechanisms inherent in natural rubber may be operating. At concentrations greater than 67 per cent, some difficulty has been encountered because of the fluid nature of the adhesive mass.

Extrapolation of the plot to 100 per cent tackifying resin indicates a viscosity of about 10,000 poises. This viscosity is a fairly realistic value for these particular rosin esters at 70 C.

The value of the method for characterization of pressure-sensitive adhesives may be illustrated in collective use of data from tack, internal strength, and viscosity determinations for Polypale Ester 10. A rosin-ester concentration of 60 per cent yields maximum obtainable tack. Lowering the concentration of tackifier from 60 to 50 per cent involves only 10 per cent loss in tack but gives a 30 per cent gain in internal strength and a gain of 50 per cent in viscosity. These conclusions represent use of this type of approach to pressure-sensitive adhesives. A practical means is available for determining the composition at which desired adhesive properties may be obtained.

The characterization has also been used to study the effect of accelerated- and natural-aging conditions in pressure-sensitive systems. Decided differences have been observed between tackifying resins on the basis of exposure to ultraviolet radiation, heat, high humidity, ozone, infrared radiation, and sunlight. These data are being correlated with the actual structure of the tackifier. The method is also readily applicable to the study of plasticizers, fillers, elastomers other than natural rubber, and new pressure-sensitive tackifiers.

Discussion of Results

In this study of pressure-sensitive systems, several definite relationships between concentration of tackifying resin and the tack, internal strength, and viscosity of the adhesive mass are evident. The ultimate elongation of the adhesive mass increases sharply after 40 per cent tackifier concentration and in a manner nearly identical to the increase of tack to a maximum. Yield stress decreases smoothly and then may increase slightly as tack decreases. Tackifier concentrations of 0 to 40 per cent apparently alter the rubber very little. However, concentrations of 40 to 60 per cent tackifier presumably cause considerable increase in the ease of deformability of the adhesive mass in terms of low loads and small deformations. Viscosity, in terms of long-term loads, decreases.

Two general observations have been made. As discussed earlier, the pressure-sensitive adhesive mass must deform sufficiently to contact the surface of a substrate. An elastomer such as natural rubber could conceivably operate as a pressure-sensitive adhesive and form a very strong bond if coiling, agglomeration, or interaction of the molecules did not restrict the contact of rubber with an adherend. The cohesive forces in many liquids and certainly in rubber are of the order of thousands of pounds per square inch. If even half or a third of these dispersion forces could be brought to bear on an adherend, a very strong bond would be possible.

A second observation of pressure-sensitive adhesion suggests a notable specificity of a large, rigid structure in pressure-sensitive tackifying resins. On the basis of points of contact between elastomer and tackifier, straight-chain fatty acid esters, for example, should be as good tackifiers as rosin esters. Presumably, dispersion forces between elastomer and tackifier bind the adhesive mass together. The straight-chain esters offer as many points of contact between ester and rubber as do the rosin esters. Moreover, any polar groups present, which would increase the bonding force, could be equally furnished by either rosin esters, or a number of other esters. Many esters other than rosin esters, when formulated with an elastomer, show a tendency either to exude or to crystallize. This indicates a mobility of the molecule in the rubber that allows polar forces to bring like molecules together. The large, rigid molecule of the rosin ester is presumably restricted in mobility.

Presence of rosin esters probably increases the area of contact between adhesive and adherend over that made by rubber alone. The areas of the adherend not contacted by rubber could be "filled" by the tackifier. This suggests that a disperse system exists at least at the surface of the adhesive. In a two-phase system, the continuous phase is probably the higher-molecular-weight rubber molecules, saturated with rosin ester. The suspended or discontinuous phase is tackifier saturated with low "ends" of rubber. The rubber is, of course, plasticized and can make considerably more contact than when used alone. The disperse phase is of much lower viscosity than the continuous phase and can fill pores and irregularities in the adherend. This may occur elastically or plastically. However, the viscosity of the continuous phase must be in excess of several hundred thousand poises in order to resist subsequent shear loads in service.

Summary

Quantitative methods for a study of factors affecting pressure-sensitive adhesion have been developed. (1) Tack is determined as a surface property that defines the instantaneous adhesiveness of the tackifying resin-elastomer mass. (2) Yield stress of free films reflects the internal strength or cohesion. (3)

A study of viscosity affords a scale for comparison of long-term flow. These have been useful in studying pressure-sensitive adhesion as a function of concentration of tackifying resin in pure rubber as well as the effects of accelerated aging. These methods can also be utilized in studying the effects of plasticizers, fillers, and stabilizers. A study of deformation is in progress.

Tack and tensile data on rosin ester-rubber systems imply a close relationship between elasticity and tack. A two-phase system involving both tackifying resin and elastomer appears to be a requisite to pressure-sensitive adhesion.

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Effect of Length to Diameter Ratio of Specimen on the Apparent Compressive Strength of Concrete

BY JOHN W. MURDOCK AND CLYDE E. KESLER

Previous investigations indicate that the value of the correction factor also depends on influences other than the length-diameter ratio

THERE are many factors which affect the apparent compressive strength of concrete, and for this reason the ASTM has established standard methods to be used for its determination. One factor affecting the compressive strength is the ratio of the length of the specimen to its diameter, commonly referred to as the l/d ratio. Figure 1 shows the variation in relative strength for various l/d ratios. Since specimens with l/d ratios other than 2.0 do not yield the same apparent compressive strength as the standard cylinder, an attempt is usually made to "correct" the strength to that which would be expected from a standard cylinder.

It may be noted from Fig. 1 that there is very little change of strength in the range of BC which is the range into which

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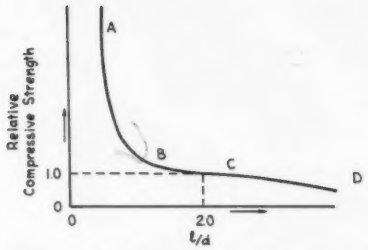

Fig. 1.—Variation of Apparent Strength of Concrete with l/d Ratio.

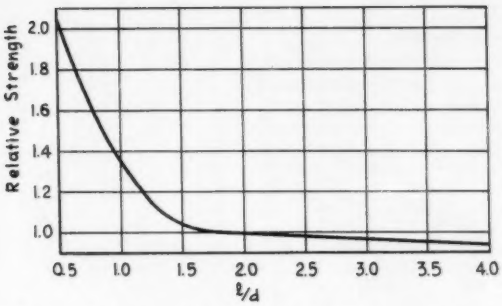

Fig. 2.—Effect of l/d Ratio on Apparent Strength (1).

most specimens fall. However, if l/d becomes small, there is a significant increase in strength, or if l/d becomes large there is a decrease in the strength. If a specimen has an l/d ratio larger than 2.0, it can generally be conveniently shortened to give an l/d ratio of 2.0. Consequently the range *CD* is not of great importance, and the discussion in this paper will be confined to the ABC range. ASTM Method C 42[1] gives a set of factors for correcting the strength of cylinders whose l/d is not equal to that for the standard cylinder. Method C 42 assumes that the correction factor depends only on the geometry of the specimen and not on the quality of the concrete itself.

It is the purpose of this paper to summarize previous investigations which indicate that the value of the correction factor also depends on influences other than the l/d ratio.

Effect of Length

The standard compressive test specimen for concrete is a 6 by 12-in. cylinder having an l/d ratio of 2.0. Because it is not always possible to obtain a specimen of standard dimensions, there have been several investigations in which efforts were made to determine correction factors which would correlate the results obtained from nonstandard specimens with those obtained from standard specimens.

Among the first to give a reasonable relation of the strength of specimens with varying l/d ratios were those conducted at the Universities of Illinois, Wisconsin, and the Massachusetts Institute of Technology. The results were published by the American Concrete Inst. in 1914 (1)[2] and are tabulated in Table I and plotted in Fig. 2. This early investigation used concrete prisms instead of cylinders, 4 by 4 in. and 8 by 8 in. cross-sections. Each phase of this investigation used concrete of the same age. The aggregates were from different sources, as was probably the cement; consequently, the results from the various research groups varied somewhat. Although this was a limited investigation, it clearly indicates that the apparent compressive strength varies inversely with the l/d ratio. The variations are more pronounced for small values of l/d than for values of l/d close to 2.0.

In 1923 G. W. Hutchinson (2) reported the results of tests made to obtain data useful in correlating the strength of cores drilled from existing pavements to that of standard specimens. More than 250 specimens were cast for this study. These specimens were 6 in. in diameter with heights varying from 3 in. to 13 in. in 1-in. increments. The concrete was hand mixed and a complete set of specimens ranging from 3 to 13 in. was cast at each pouring. Mixes of 1:3:6 and 1:1.5:3 proportions were used in which the sand and cement were mixed first and then the coarse aggregate and water added. The coarse aggregate was a crushed granite separated and recombined so that 60 per cent ranged in size from $\frac{3}{8}$ to $\frac{3}{4}$ in. and 40 per cent from $\frac{3}{4}$ to $1\frac{1}{2}$ in. The specimens were left in the molds for 24 hr and then removed and stored at 90 per cent relative humidity and 70 to 75 F until tested. The specimens were tested wet. The results are given in Table II, each value being the average of 2 to 4 tests.

Hutchinson confined his conclusions to specimens in which the l/d ratio varied between limits of 0.5 and 2.0, since the data on the specimens whose l/d ratio was less than 0.5 were erratic. He considered the variations due to the strength of concrete specimens to be negligible and within the limits of test error. The strength relationship obtained is shown in Fig. 3. Two curves, determined from the average of sets 1 and 2 and sets 6 to 8, inclusive, have been added to give an indication of the relative influence of modifications of size on concretes of low and high inherent strengths.

The most comprehensive investigation to determine the extent of size effect was reported by Gonnerman (3) in 1925. The concrete used in the study of the effect of the l/d ratio was either a 1:3 or 1:5 mix by volume. The fine aggregate was well graded and ranged in size from 0 to that which passed a No. 4 sieve. The coarse aggregate was determined by the fineness modulus. All concrete

TABLE I.—RELATIVE STRENGTHS OF CONCRETE PRISMS OF DIFFERENT HEIGHT, BASED ON STRENGTH OF PRISM WITH l/d RATIO OF 2.0. *PROCEEDINGS*, AM. CONCRETE INST. (1).

l/d	Average Strength Ratio	Height, in.		Compressive Strength, psi					
		4 by 4-in. Cross-Section	8 by 8-in. Cross-Section	4 by 4-in. Cross-Section			8 by 8-in. Cross-Section		
				a	*b*	*c*	*a*	*b*	*c*
0.50..	2.09	2	4	6485	4320	5046	5480	4730	...
0.75..	1.66	3	6	5170	3245	3672	4192	3596	4242
1.00..	1.38	4	8	3811	2915	2688	3898	3143	3666
1.50..	1.04	6	12	3306	2075	2288	2948	2260	2301
2.00..	1.00	8	16	2623	2265	1993	2981	2263	2342
3.00..	0.97	12	24	2732	2175	1910	2818	2146	2590
4.00..	0.94	16	32	2137	2423	1976	2689	2145	2196
6.00..	0.88	24	..	2513	2305	1883	...	...	...

[a] University of Illinois tests.
[b] University of Wisconsin tests.
[c] Massachusetts Institute of Technology tests.

[1] Methods of Securing, Preparing, and Testing Specimens from Hardened Concrete for Compressive and Flexural Strengths (C 42 – 49), 1955 Book of ASTM Standards, Part 3, p. 1360.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

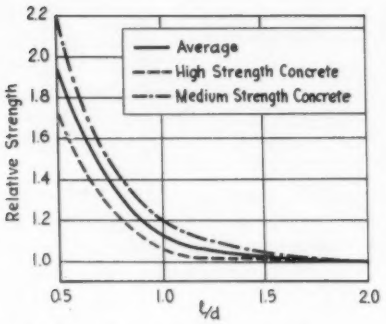

Fig. 3.—Effect of l/d Ratio on Apparent Strength, Hutchinson (2).

TABLE II.—COMPRESSIVE STRENGTHS OF 6-IN. DIAMETER CONCRETE CYLINDERS OF VARYING HEIGHT. HUTCHINSON (2).

Set	Compressive Strength, psi									
	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.	12 in.	13 in.
1	2573	1925	1492	...	1229	1129	998	1007	966	1064	991
2	3353	2206	1847	1793	1527	1652	1541	1581	1469	1413	1432
3	4812	3110	2632	2305	2043	2113	2022	2035	1980	1863	1996
4	4652	3762	3135	2739	2431	2391	2360	2281	2163	2278	2257
5	4915	3715	3096	2722	2511	2620	2480	2576	2497	2499	2524
6	5766	4456	3914	3818	3345	3133	3140	3091	3053	3109	2900
7	5825	5123	4142	3763	3674	3683	3624	3533	3654	3479	3429
8	6824	5643	4799	4667	4356	4542	4315	4179	4091	4185	3936
Average	4830	3743	3132	3087	2640	2658	2560	2535	2485	2486	2433

TABLE III.—EFFECT OF VARIATION OF LENGTH OF SPECIMEN ON APPARENT STRENGTH OF CONCRETE FOR 6-IN. DIAMETER CYLINDERS (GONNERMAN (3)).

Mix Proportions	3 in.	6 in.	9 in.	12 in.	15 in.	18 in.	24 in.
1:5	1.98	1.12	1.00	1.00	0.98	0.96	0.92
1:3	1.68	...	0.96	1.00	0.88	0.89	0.89

TABLE IV.—EFFECT OF l/d RATIO ON APPARENT STRENGTH OF CONCRETE WHEN AGGREGATE AND SLUMP IS VARIED. (JOHNSON (4).)

Relative strengths based on strength of 6 by 12-in. cylinder.

l/d Ratio	¾-in. Aggregate			1½-in. Aggregate		
	1-in. Slump	3-in. Slump	6-in Slump	1-in. Slump	3-in. Slump	6-in. Slump
Cast Horizontally						
1.00	1.048	1.094	1.075	1.093	1.094	1.123
1.33	1.080	1.059	1.060	1.066	1.101	1.046
1.67	1.024	1.084	1.012	0.995	1.011	0.993
2.00	1.000	1.000	1.000	1.000	1.000	1.000
2.83	0.937	0.967	0.955	0.990	0.953	0.939
Cast Vertically						
1.00	1.130	1.071	1.137	1.167	1.094	1.113
1.33	1.069	1.035	1.057	1.080	1.039	1.042
1.67	1.073	1.012	1.039	0.970	0.914	0.946
2.00	1.000	1.000	1.000	1.000	1.000	1.000
2.83	1.017	0.939	0.928	0.980	0.970	0.900

was hand mixed in batches of approximately 1 cu ft and the consistency was measured by means of the flow table. In general the relative consistency was 1:1. The concrete was placed in the forms in layers and each layer was thoroughly rodded. Each specimen was kept moist until tested and was tested wet. The results of these tests are listed in Table III and plotted in Fig. 4.

In general, Gonnerman concluded that when the l/d ratio varied between the limits of 1.5 and 2.5 the specimen strengths were within 5 per cent of the standard cylinder strength. The apparent strength showed a marked increase when the l/d ratio fell below 1.5 and decreased slightly when the l/d ratio exceeded 2.5. At ratios of 3.0 and 4.0, the apparent strengths were 95 and 90 per cent, respectively, of the 6 by 12-in. cylinder strength. The limited variations in the apparent strength which is exhibited over a rather wide range of values of the l/d ratio minimizes the effect of minor variations in the dimension of the specimen such as those which might be caused by shrinkage or planing the ends for testing. Gonnerman's results are in substantial agreement with those of other investigators although there is some discrepancy in the magnitude of the variation at small values of the l/d ratio.

In a study made by John son (4) in 1943, different size aggregates and different slumps were used. All the mixtures were 1:3.04:3.71, proportioned by weight. Some of these specimens were made with concrete in which the maximum size aggregate was $1\frac{1}{2}$ in. and in the remainder the maximum size aggregate was $\frac{3}{4}$ in. Mixes using both sizes of aggregates were poured with slumps 1, 3, and 6 in. All specimens were of 6-in. diameter and the heights were 6, 8, 10, 12, and 17 in. Specimens were cast both horizontally and vertically. In general the vertically cast test specimens showed the greater strength but the difference was slight.

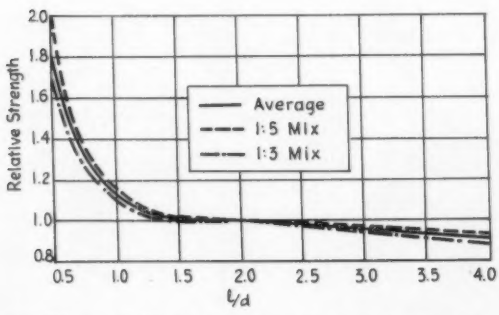

Fig. 4.—Effect of l/d Ratio on Apparent Strength for 6 in. Diameter Specimens, Gonnerman (3).

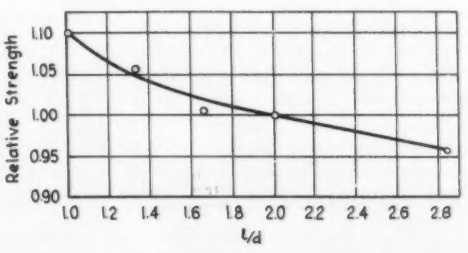

Fig. 5.—Effect of l/d Ratio on Apparent Strength, Johnson (4).

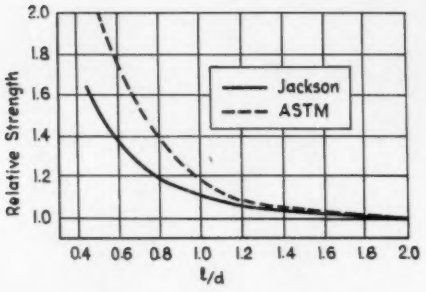

Fig. 6.—Effect of l/d on Apparent Strength, Jackson (5).

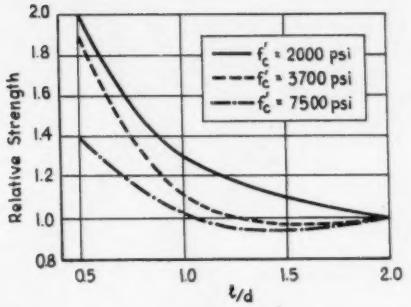

Fig. 7.—Effect of l/d Ratio on Apparent Strength, University of Illinois, 1954.

The results of this study are given in Table IV and Fig. 5.

In 1944 Jackson (5) reported a set of correction factors which had been determined from the results of tests on more than 2000 specimens. Each specimen had a diameter of 6 in. while the heights varied from $2\frac{5}{8}$ to $11\frac{5}{8}$ in. The strength of the concrete was not given. The factors as given by Jackson are plotted in Fig. 6 and for comparison the reciprocals of the ASTM factors are plotted in the same figure.

In 1955, a few tests were made at the University of Illinois from which data were obtained to determine the relative influence of size effect on concretes of different inherent strengths, utilizing concretes of low, medium, and high strength. Test specimens were 6 in. in diameter and of 3, 6, 9, and 12-in. heights. Natural sand and gravel were used; the maximum size of the aggregate was 1 in. In all cases, the 6 by 12-in. cylinders in this investigation had neat cement caps applied at the time of casting. Hydrocal caps were used on all other specimens.

The results of these tests, given in Table V and Fig. 7, indicate that concretes of the greatest strengths are markedly less affected by variations in the size of the test specimen. In concretes of medium and high strength this study indicated an initial reduction in the apparent strength as the l/d ratio decreases, but this trend reverses itself and, as in previous investigations, an inverse relationship between the l/d ratio and the apparent compressive strength was found. This initial reduction is a phenomenon not noted by other investigators and is probably caused by the type of cap used in the tests, although for the medium strength concrete the hydrocal cap used should have been satisfactory.

TABLE V.—EFFECT OF l/d RATIO ON APPARENT STRENGTH OF CONCRETE OF DIFFERENT INHERENT STRENGTH (UNIVERSITY OF ILLINOIS, 1954).

l/d Ratio	Strength, psi		
2.00.....	7 500	3700	2000
1.50.....	7 070	3590	2220
1.00.....	7 680	4120	2600
0.50.....	10 400	7070	4100

The effect of the length of the test specimen on the apparent compressive strength of concrete has been analyzed statistically by Tucker (6). He divides specimens into two classifications: first those in which unrestrained shear may occur and secondly those in which the shear failure is restrained. From these studies he concluded that the minimum length of a specimen in which an unrestrained behavior may occur is the product of the diameter and the tangent of the angle of failure. He found the most common value of the angle of failure to be 52.5 deg and computed that the minimum length of specimen in which an unrestrained failure could occur would be one in which l was at least equal to 1.3 times the diameter. If the length of the specimen was greater than this, the location of the failure would depend on the strength dispersion. Tucker's statistical correction factors for specimens in which an unrestrained failure may occur do not check precisely although they are indicative of the results expected.

In discussing variations of apparent strength of restrained specimens, Tucker considers the possibility of changes in the angle of internal friction. He plots theoretical values which show resultant apparent strengths for different values of the angle of internal friction and compares them to curves obtained from tests of concrete of different strengths. His theoretical correction factors are plotted in Fig. 8, and Fig. 9 is a replot of Hutchinson's data which Tucker used for comparison with his theoretical calculations. These curves are similar to those obtained at the University of Illinois.

The relative influence of size effect

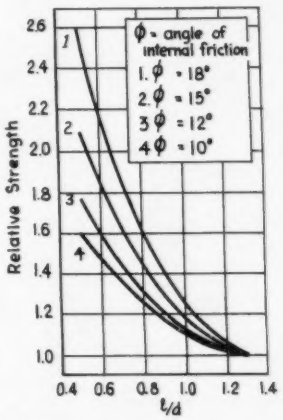

Fig. 8.—Effect of l/d Ratio on Apparent Strength, Tucker (6).

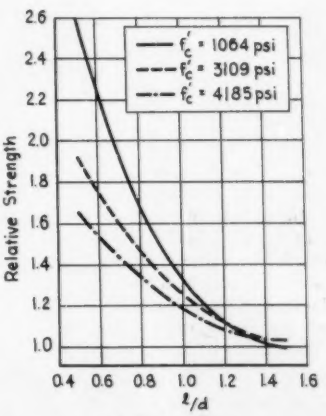

Fig. 9.—Effect of l/d Ratio on Apparent Strength (Hutchinson's Data), Tucker (6).

on concretes of various strengths is shown in Fig. 10, in which the results of specimens with an l/d ratio of 0.5 is compared to that of specimens with an l/d ratio of 2.0. The influence of l/d for various strengths of concretes is greatest for this particular value; however it does indicate what may be expected to occur for other values of l/d when the concrete strength is varied. The curve clearly points out that one set of correction factors is good apparently for only one concrete strength, or, at best a limited range of strengths.

Tucker concluded that in restrained specimens the apparent strength is a factor of both end restraint and inherent strength; unrestrained failures are factors of strength dispersion. He recommended test specimens whose minimum length is no less than $1.3d$. For l/d ratios between 1.5 and 2.0 he suggested a 3 per cent reduction in apparent strength to correct the test results to those from standard cylinders.

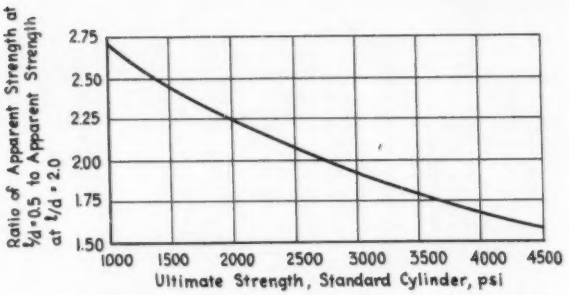

Fig. 10.—Relative Influence of l/d Ratio on Apparent Strength of Concretes of Different Inherent Strengths, Tucker (6).

Comparison of Cylinder and Cube Strength

Although most compression tests of concrete are made on cylindrical specimens, it is frequently necessary to use specimens of different shapes. Results of investigations in which the cube or modified cube strengths have been compared to those of the standard cylinder show the effect of strength on the suggested correction factors. It has been suggested that ASTM Method C 116,[3] should contain a correction factor for modified cubes in much the same manner as C 42 contains correction factors for cores of different lengths.

Some of Gonnerman's (3) results of studies to determine the relationship between the strengths obtained from cylinders and cubes are given in Table VI. It may be noted that the 6-in. cubes and 8-in. cubes give higher strength than the 6 by 6-in. cylinders, all of which were higher than the standard cylinder.

Koenitzer (7) investigated the use of modified cubes as a substitute for the standard compression cylinder in highway field tests. To justify this substitution, he conducted tests to establish the relationship between the strength of modified cubes and standard compression cylinders. In these tests, Koenitzer used two mixes of concrete. The first, with a type I cement and sand and gravel aggregates, had a water-cement ratio of 5 gal per sack. The second was made with type III cement, fine aggregate, and limestone and had a water-cement ratio of $5\frac{1}{4}$ gal per sack. Flexure specimens and cylinders were cast in accordance with ASTM specifications. The beams were broken in flexure at the ages of 4 and 10 days and the resulting modified cubes, a minimum of 7 in. in length, were capped on both sides with a 1:1 mixture of cement and plaster of Paris. After capping, the modified cubes were moist-cured until tested. The compression test used 6 by 6-in. bearing plates directly opposed, and the specimens were so placed as to obtain a symmetrical overhang varying from 1 to 3 in.

In tests of 66 standard cylinders and 66 modified cubes, all made with sand and gravel aggregate, Koenitzer found the average cylinder strength to be 4045 psi and the average modified cube strength to be 3993 psi. The tests of his limestone aggregate concrete included 26 standard cylinders and 26 modified cubes. The average cylinder strength was 3994 psi and the modified cube strength was 4008. From the results of these tests Koenitzer concluded that modified cubes could be substituted for standard compression cylinders and that no strength correction need be made. Koenitzer's conclusion that no correction factor need be applied is unique. Inspection of his data reveals a wide variation in his modified cube

TABLE VI.—RELATIVE STRENGTHS OF CYLINDERS AND CUBES BASED ON THE APPARENT STRENGTH OF 6 BY 12-IN. CONCRETE CYLINDERS. AGE AT TEST VARIED.

Age	6 by 6-in. Cylinder	6-in. Cube	8-in. Cube	6 by 12-in. Cylinder
7 days..	1.32	1.40	1.30	1.00
28 days..	1.12	1.16	1.15	1.00
3 mo...	0.99	1.05	0.96	1.00
1 yr....	1.15	1.12	1.02	1.00

TABLE VII.—COMPARISON OF STRENGTHS, PSI, EXHIBITED BY LABORATORY CAST STANDARD CYLINDERS AND CAST MODIFIED CUBES OF VARYING LENGTH. (BRYANT MATHER (8).)

Strength of Cubes Corrected by ASTM Factors.

Standard Cylinder	6 by 6-in. Modified Cubes			
	$6\frac{1}{4}$-in. Length	8-in. Length	10-in. Length	12-in. Length
3695.	3080	3120	3045	3080
4525.	3815	3920	4065	4015
5262.	4095	4535	4405	4450

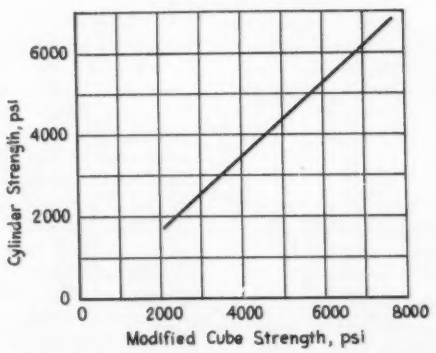

Fig. 11.—Statistical Relationship Between Apparent Strength of Standard Cylinders and Modified Cubes, Kesler (9).

[3] Method of Test for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure (Modified Cube Method) (C 116 – 49), 1955 Book of ASTM Standards, Part 3, p. 1310.

strength. In the first tests, these strengths ranged from 25 per cent greater to 25 per cent lower than the companion cylinder strength, and in the second tests they ranged from 38 per cent greater to 16 per cent lower.

Mather (8) conducted a series of tests in which he compared the strength of cylinders and modified cubes. The first investigation consisted of laboratory-cast standard cylinders and cast modified cubes of varying lengths. All specimens were provided with sulfur-silica caps and tested damp. The specimens were fog cured for 28 days after casting. The concretes used were made with various water-cement ratios and in some mixes admixtures were used.

The data for these tests are given in Table VII, and include the corrections as given by the factors in Methods C 42. It is apparent that concretes of greater inherent strengths are not influenced to the same extent by the effect of shape, and obviously a different correction factor is needed.

The results of some tests on standard cylinders and modified cubes of different strengths are reported by Kesler (9) and are indicated in Fig. 11. The relationship shown was established from approximately 600 modified cubes and 500 cylinders. The slope of the line indicates that the relationship between the modified cube strength and the cylinder strength is not constant and any correction factor depends on the strength of the concrete.

Conclusions

It is obvious from the results discussed that the l/d ratio influences the apparent strength of the concrete and that for l/d ratios of less than 1.3 there is a significant increase in the apparent strength. There is little change in the apparent concrete strength when the l/d ratio is between 1.5 and 2.5. It is further indicated that the correction factor needed must vary according to the strength of the concrete; that no one set of correction factors will be good for all concrete strengths. It may also be noted that the result of tests for which the l/d ratio is less than 1.0 are erratic, indicating that perhaps specimens with l/d ratio below 1.0 should not be tested.

The danger in the use of one set of correction factors is apparent when weak concretes with low l/d ratios are tested. The use of a single set of correction factors, as given by Methods C 42, gives the weaker concretes corrected strengths higher than the probable strength of a cylinder with an l/d ratio of 2.0 made of the same concrete. This is an important consideration since it is the weak concrete in which most or much of the difficulty is encountered in the accepting or rejecting of structures. High-strength concrete is penalized by the present set of correction factors.

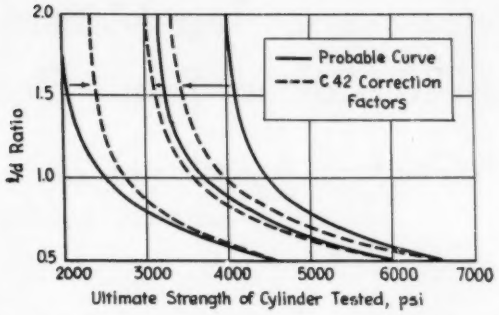

Fig. 12.—Suggested Graphs for Correcting Strength of Cylinders with l/d Different Than 2.0 to the Expected Strength of Standard Cylinders.

Need for Additional Information

It has been suggested that a study be made to determine if it is desirable to present in Methods C 42 a method for correcting concrete strengths obtained from cylinders whose l/d is not 2.0. Perhaps Method C 116 should be included in the study. Such general correction factors are probably not of interest to research workers who will in most cases establish their own if needed. Factors established in this manner would be for the particular conditions at hand. If a general set of factors is not given, many organizations will establish their own, with many different values resulting. It is difficult to say whether this would be a good practice. For instance, the influence of different aggregates on the correction factors is not known and perhaps individual correction factors would be more appropriate. This, however, would result in confusion in interchange of test data. Many other arguments may be advanced for either continuing or dropping the publication of correction factors in Methods C 42 and C 116.

If the inclusion of correction factors is continued, then perhaps a graph such as the solid lines in Fig. 12 might be presented. Each solid curve represents one quality concrete. Such a chart could easily take into account the effect of strength. The values on the abscissa are presented only for discussion purposes and should not be considered exact. The dashed lines are based on the correction factors given in Methods C 42. The solid lines represent more nearly the correct factors. It is obvious from observing the apparent strength for an l/d ratio of 0.5 that the low-strength concrete benefits and the high-strength concrete is penalized by the "ASTM curves."

Sufficient data are not available to determine such curves as given in Fig. 12 or to determine the proper correction factors. A well-organized research program is indicated, including as variables not only strength but moisture content, curing aggregate type, and perhaps admixtures.

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(2) G. W. Hutchinson, "Correction Data for Comparative Test Results from Field Data," *Proceedings*, Am. Concrete Inst., Vol. 19, p. 191 (1923).

(3) H. F. Gonnerman, "Effect of Size and Shape of Test Specimen on Compressive Strength of Concrete," *Proceedings*, Am. Soc. Testing Mats., Vol. XXV, Part II, p. 237 (1925).

(4) J. W. Johnson, "Effect of Height of Test Specimen on Compressive Strength of Concrete," ASTM Bulletin, No. 120, Jan., 1943, p. 19.

(5) F. H. Jackson, Letter to Engineering Director, National Sand and Gravel Assn., Oct. 17, 1944.

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(7) L. H. Koenitzer, "Proposed Method of Making Compression Tests on Portions of Concrete Beams from Flexural Tests," *Proceedings*, Am. Soc. Testing Mats., Vol. 34, Part II, p. 406 (1934).

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Development of Test Methods for Thermal Stability of Varnished (Coated) Fabric Electrical Insulating Materials*

A Progress Report from a Special Task Group[1] of ASTM Committee D-9 on Electrical Insulating Materials

Purpose of Section F

The original purpose of Section F, Subcommittee VII, ASTM Committee D-9 on Electrical Insulating Materials upon its formation in 1953, was to develop methods of tests for "thermal stability" of varnished and coated fabrics used for electrical insulation. In view of the large amount of work involved, the development of control, lot acceptance, or identity test methods would not be a primary purpose. It has also been understood that the initial efforts of the Section would be limited to materials directly under the cognizance of Subcommittee VII on Insulating Fabrics and, for the present, combinations of these with other materials would not be considered.

The work has been directed toward developing test methods suitable for thermal classification of varnished fabrics in the sense contemplated in AIEE Standard No. 1. At present, it appears that it may be possible to compare temperature stability of different materials on a relative basis by the test methods being considered. For example, a new material may be compared to an accepted material on which considerable field experience is available.

Sound engineering reasoning and experience must be used in interpreting the results of the tests, weighing the extent to which the methods approximate the application and conditions of service and the degree to which extrapolation to lower (or higher) temperatures is justifiable. The test methods may not permit assignment of a numerical temperature rating to a material, such as 105 C for a specific varnished-cambric material.

There is evidence that materials of different nature fail in different ways. For example, silicone-varnished glass cloth fails by crazing action resulting possibly from differences of thermal expansion between the silicone resin and the glass. Silicone rubber-coated glass apparently fails by a different action, possibly due to discontinuities in the silicone rubber resulting from the heat aging and mechanical stress.

The Arrhenius' equation has been used as a basis for extrapolation of aging times at elevated temperatures to expected life at the hottest-spot temperature.[2] Sufficient data have not yet been accumulated to prove whether or not this equation is applicable to the methods studied.

In all the tests to date, some type of mechanical stress, either during or after heat aging, has been applied to accelerate failure. Heat shock resulting from rapid change from the hot oven to room ambient is also believed to have a marked effect.

Organizing the Test Program

The section first collected information on work already done on thermal stability of varnished fabrics. A paper on this subject had been presented at the ASTM Symposium on Temperature Stability of Electrical Insulating Materials[3] held in June, 1954. At a meeting of Section F in March, 1954, a task group was commissioned to review all AIEE and ASTM papers on the subject and to recommend methods worthy of further investigation by the Section. The task group recommended that a "Curved-Electrode Method," be studied further, and at a meeting of Section F in November, 1954 it was unanimously agreed to try not only this method but a "Wrapped-Bar Method."

At this same meeting a new task group evenly balanced between producers and consumers was organized to carry on the program. Four members of the group furnished the test materials and eight of the laboratories represented agreed to conduct tests. Due to unforeseen circumstances several laboratories have been unable to conduct tests as originally planned but, as of April, 1956, six laboratories have been active in testing.

As a result of several meetings held in 1954 and 1955, agreement was reached on the following:

(*a*) The materials to be studied.
(*b*) The laboratories testing specific materials—at least two for each of the materials by each method.
(*c*) Details of the two methods to be investigated.
(*d*) Initial heat-aging temperatures to be studied.

Temperatures were selected to give a deliberately short life so that from this information lower temperatures could be more intelligently chosen.

The materials being tested are:

1. Yellow organic-varnished cotton cloth.
2. Black organic-varnished cotton cloth.
3. Yellow organic-varnished glass cloth.
4. Black organic-varnished glass cloth.
5. Silicone-varnished glass cloth, material X.
6. Silicone-varnished glass cloth, material A.
7. Silicone rubber-coated glass cloth, material E.
8. Silicone rubber-coated glass cloth.

It was agreed to use the following heat-aging temperatures in both the curved-electrode and wrapped-bar tests:

1. Organic-varnished cotton cloth, 160 C.
2. Organic-varnished glass cloth, 200 C.
3. Silicone-varnished glass cloth, 300 C.
4. Silicone rubber-coated glass cloth, 300 C.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* This paper was presented at the Winter General Meeting of the American Institute of Electrical Engineers held in New York City, January, 1957.

[1] Members of the Task Group of Section F on Heat Stability of Subcommittee VII on Insulating Fabrics, are: L. E. Sieffert, U. S. Bureau of Ships, Chairman; H. K. Graves, Material Laboratory, New York Naval Shipyard; K. Wechsler, Westinghouse Electric Corp.; H. M. Philofsky, Westinghouse Electric Corp.; J. Dexter, Dow Corning Corp.; T. R. Walters, General Electric Co.; J. S. Boyle, New Jersey Wood Finishing Co.; L. J. Timm, Irvington Varnish and Insulator Division, Minnesota Mining and Manufacturing Co.; P. M. DiCerbo, General Electric Co., K. N. Mathes, General Electric Co.

[2] T. W. Dakin, "Electrical Insulation Deterioration Treated as a Chemical Rate Phenomenon," *Transactions*, Am. Inst. Electrical Engrs., Vol. 67, pp. 113–122 (1948).

[3] Symposium on Temperature Stability of Electrical Insulating Materials, (Symposium issued as separate publication) *STP No. 161*. Am. Soc. Testing Mats., (1954).

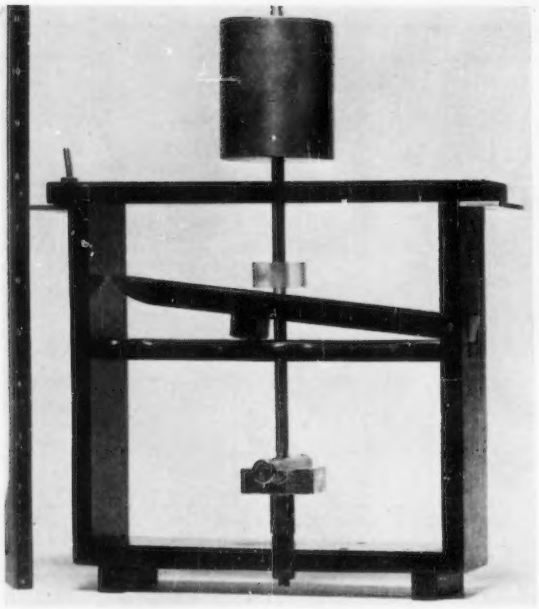
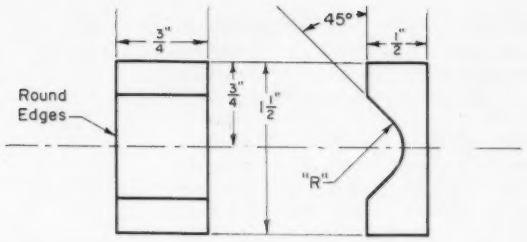
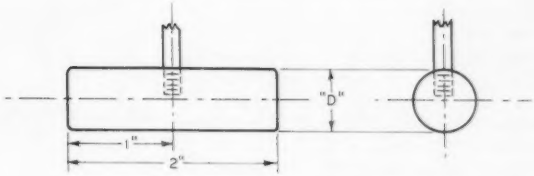


Fig. 1.—Curved Electrode and Holder for Thermal Stability Tests of Flexible Sheet in Insulation.



Insulation Thickness, in.	R, in.	Tolerance, in.
0.007	0.172	± 0.001
0.010	0.246	± 0.001
0.012	0.295	± 0.001



Insulation Thickness, in.	D, in.	Tolerance, in.
0.007	0.336	± 0.001
0.010	0.480	± 0.001
0.012	0.576	± 0.001

Fig. 2.—Single Shot Curved Electrode.

Actual tests were started in June, 1955, and experience with the materials at the above temperatures led to the decision at the November, 1955 meeting to use the following additional heat-aging temperatures in both the curved-electrode and wrapped-bar tests:

1. Organic-varnished glass cloth, 175 C.
2. Silicone-varnished glass cloth, 275 C.
3. Silicone rubber-coated glass cloth, 275 C.

With further experience, it was agreed at the April, 1956 meeting to employ additional lower temperatures in the heat-aging tests using the wrapped-bar specimen as follows:

1. Organic-varnished glass cloth, 160 C.
2. Silicone-varnished glass cloth, [225 C and 200 C.
3. Silicone rubber-coated glass cloth, 225 C and 200 C.

In the case of the curved electrode, sufficient results were not available on which to base a decision selecting a third temperature.

Test Methods

Curved-Electrode Method

Basically, this method measures the short-time (500 v per sec rate of rise) dielectric breakdown at room conditions prior to aging and after various intervals of heat aging.

The electrode system is designed to bend the specimen in such a way that the material is elongated approximately 2 per cent. A single-shot electrode is pictured in Fig. 1 and described in Fig. 2.

Heat aging is continued and dielectric breakdown measured at approximately 10 intervals until 200 v per mil (based on original thickness of the material) is reached.

Some of the laboratories also used the curved electrode method as a dielectric proof test. In this case, rather than measuring dielectric breakdown, an arbitrary dielectric proof voltage of 200 v per mil was applied for approximately 1 sec, after various intervals of heat aging. By a statistical procedure, the heat aging time to failure of 50 per cent of the specimens was determined.

Other end points than 200 v per mil, for example, 300 v per mil, 400 v per mil, 50 per cent of initial dielectric strength, etc., have been suggested, but no definite decision has been made that a dielectric proof test at any of these voltage levels can ultimately be adopted as standard for a variety of materials.

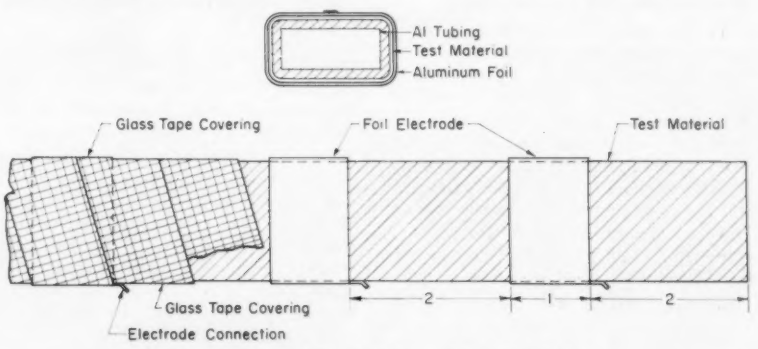


Fig. 3.—Wrapped Bar for Thermal-Stability Tests.

Curves of breakdown voltage *versus* time have shown that if an arbitrary voltage end point is selected, the curve for a particular material may approach the voltage level selected asymptotically and the point (time) at which it crosses this level cannot be determined. The curve for one material for example, showed points slightly below and above the 200 v per mil level all the way from 70 hr to 800 hr.

At a meeting of the Task Group in April, 1956, it was agreed that for the sake of simplicity the results of the curved-electrode tests using 200 v per mil proof voltage would not be included in this paper.

Wrapped-Bar Method

This method measures the short-time dielectric breakdown at room conditions prior to aging and after various intervals of heat aging. A sample 5.75 by 18 in. is tightly wrapped $1\frac{1}{4}$ turns around an 18-in. long rectangular aluminum tube so that each of the four corners of the tube is covered with a single layer of material. The tube is 1.5 by 0.75 in. in outer dimensions with a 0.125-in. wall and with the corners rounded to a $\frac{1}{16}$-in. radius. The outer electrodes are 1-in. wide strips of $\frac{1}{2}$ to 1 mil aluminum foil wrapped around the bar over the test material. Lead foil was originally used but was found to react with the silicone rubber-coated glass cloth at 300 C. These electrodes are so spaced that flashover will not occur. After the above assembly is completed the entire bar is wrapped with a single butt lap layer of 0.003-in. glass tape wound under a 10-lb tension. Figure 3 is a schematic diagram of the assembly.

The assemblies are heat aged and removed at intervals until the dielectric breakdown is reduced to 200 v per mil (based on original thickness of the material). The dielectric breakdown in kilovolts is then plotted against heat-aging time.

Discussion of Results

Selected Data from Limited Results

In Figs. 4 to 10 inclusive, are plotted some of the results obtained to date. Only a part of the data is presented to illustrate some of the more important findings in the course of the program. It is emphasized that the program has been in progress only about one year. Many tests have been initiated but have not been completed. Proposals offered and conclusions drawn in the discussions that follow must therefore be considered as tentative and only partially supported by data.

Interpretation of Data

In most of the applications for varnished and coated fabrics the life at the hottest-spot temperature should be at least in the range between 10,000 and 100,000 hr. It is dangerous to extrapolate to lives of this order from data obtained at temperatures too far above the hottest-spot temperature. If, for example, 200 v per mil dielectric strength is assumed to represent the end of life, the lives of silicone-varnished glass cloth A by the curved-electrode method at 300 C, 275 C, and 250 C determined from the data in Fig. 4 would be shown by three points *a*, *b*, and *c* in Fig. 5. If a straight line best fitting *a*, *b*, *c* is plotted, a large degree of uncertainty exists as to the accuracy of life at the hottest-spot temperature determined by extrapolation on this line. In such cases, aging time at a fourth (lower) temperature would be essential to determine whether linearity exists over the temperature range investigated and whether all points obtained should be considered in the extrapolation. It should be kept in mind that these particular three points were determined with an unusual degree

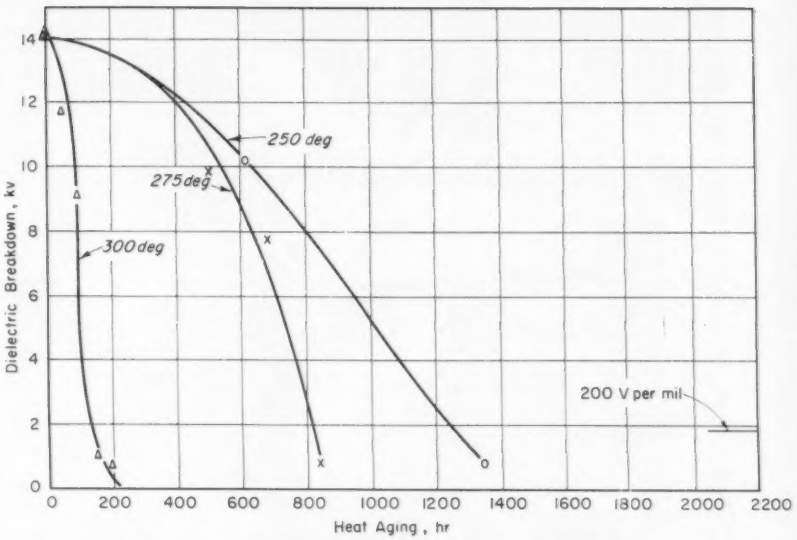


Fig. 4.—Effect of Heat Aging at Various Temperatures on Dielectric Breakdown of Silicone-Varnished Glass Material A, 9.0 Mil; Curved Electrode.

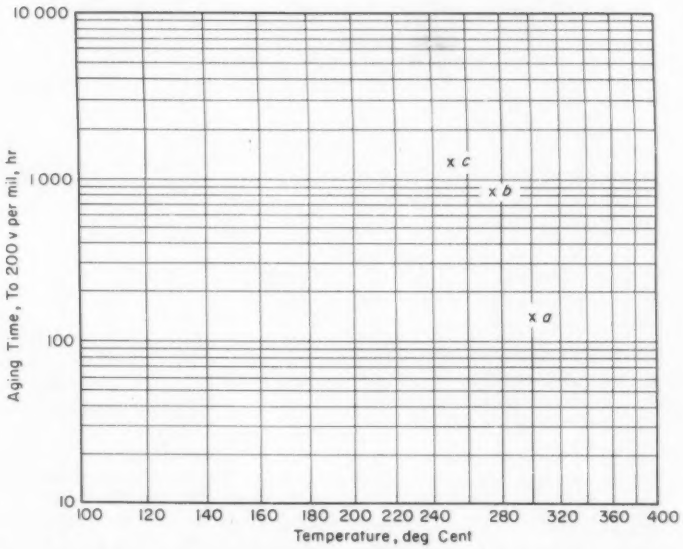


Fig. 5.—Life of Silicone-Varnished Glass Cloth Material A, 9.0 Mil; Curved Electrode.

TABLE I.—LIFE AT 200 V PER MIL END POINT.

	Life, hr	
	Wrapped Bar	Curved Electrode
Silicone-varnished glass cloth A at 300 C	5	160
Silicone rubber glass cloth E at 300 C	>440	1300
Black organic-varnished glass cloth at 200 C	250	340

of certainty in that the breakdown curves crossed the 200 v per mil line at almost a right angle.

If it was assumed for the moment that 200 v per mil dielectric strength represents the end of life, the lives determined from the curves in Figs. 6 and 7 would be about as shown in Table I.

It is apparent here that 300 C is too high a temperature to use on silicone-varnished glass cloth with the wrapped bar and it also appears that although the wrapped bar is much more severe on some materials than the curved electrode, at the above temperatures, the two may give not greatly different thermal life on other materials.

Change in Rank from Change in End Point in Curved-Electrode Test at 275 C

Examination of the heat-aging data at 275 C by the curved-electrode method presented in Fig. 8 shows the approximate number of hours of aging to reach three different end points, 200, 300, and 400 v per mil. These values are listed in Table II.

It will be noted that the two silicone-varnished glass cloth materials at the end of life drop rapidly in dielectric breakdown while the dielectric breakdown of the silicone rubber-coated glass cloth drops quite rapidly at first and then levels off. It therefore makes little difference in heat-aging life of the silicone-varnished glass cloth at 275 C whether 200 v per mil, 300 v per mil, or 400 v per mil is chosen as the end point. It makes a great difference, however, in the heat-aging life of the silicone-rubber-coated glass cloth. At 200 v per mil, the silicone rubber material would show a longer life than the better of the two silicone varnished materials while at 400 v per mil it would be only slightly better than the poorer of the two. Clearly, it is preferable to examine the entire dielectric breakdown *versus* time curve rather than to rely on any one end point in reaching decisions as to the relative heat stability at a given temperature.

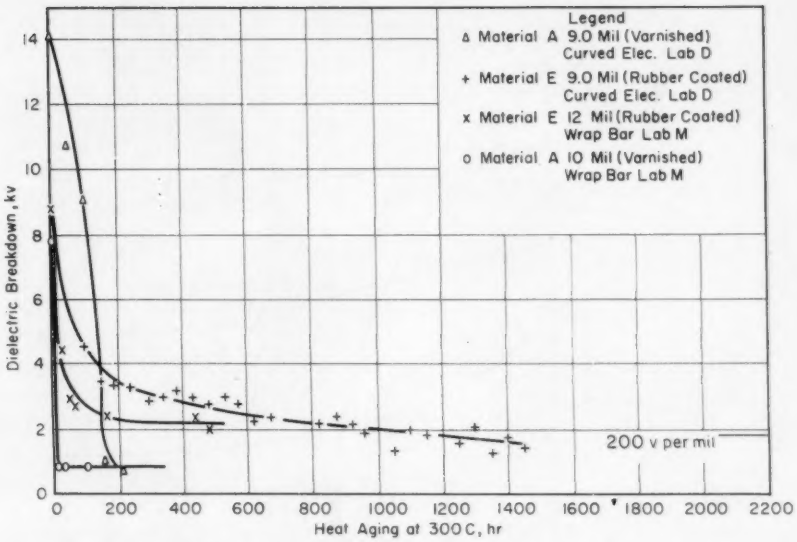


Fig. 6.—Effect of Heat Aging at 300 C on Dielectric Breakdown of Silicone Glass.

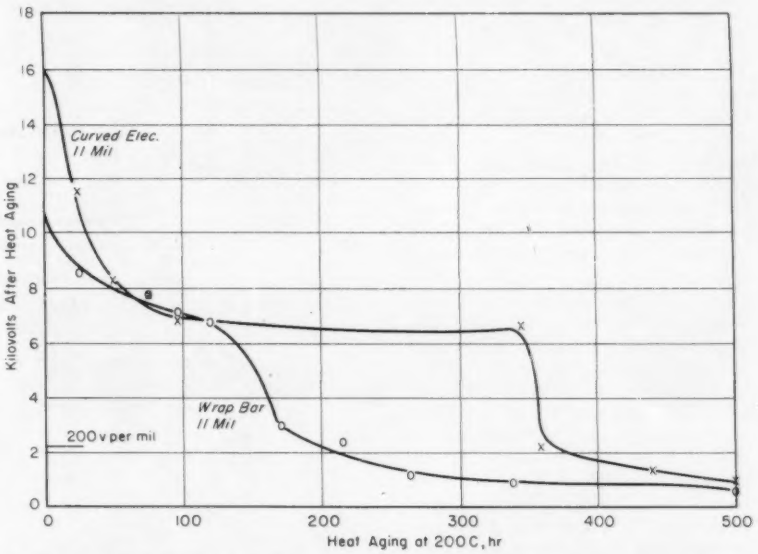


Fig. 7.—Effect of Heat Aging at 200 C on Dielectric Breakdown of Black-Organic-Varnished Glass Cloth.

TABLE II.—LIFE AT 275 C; THREE END POINTS.

Material	Approximate Life, hr		
	200 v per mil	300 v per mil	400 v per mil
Silicone rubber-coated glass cloth E	>2700	1900	910
Silicone-varnished glass cloth X	2600	2500	2400
Silicone-varnished glass cloth A	820	800	780

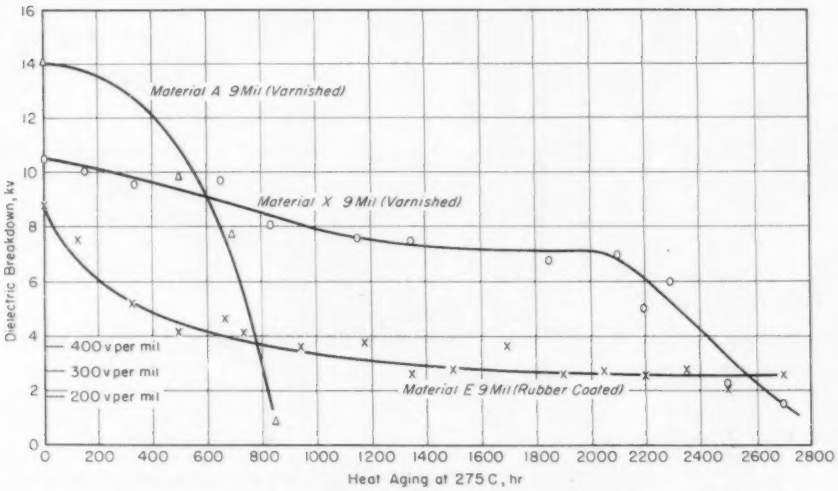


Fig. 8.—Effect of Heat Aging at 275 C on Curved-Electrode Dielectric Breakdown of Silicone-Glass Materials.

Severity of Wrapped-Bar Test on Silicone-Varnished Glass Materials at Temperature 250 C and Higher

Figure 8 also shows a considerable superiority of silicone-varnished glass cloth X over silicone varnished glass cloth A in life at 275 C in the curved electrode test. This superiority is hardly noticeable in the wrapped-bar test at 275 C as illustrated in Fig. 9. In fact, the results shown in Fig. 10 indicate that 250 C is too severe a test on silicone-varnished glass cloth materials using the wrapped-bar method. The differential expansion between the outer glass tape and the inner aluminum tube at these temperatures is such that a great stress is exerted on the material at the four corners of the tube. Visual examination of the silicone-varnished glass cloth at the conclusion of the tests shows damage at these points and in some cases the varnish has in effect disappeared. Tests are now in progress to determine the severity of the wrapped-bar test on both silicone-varnished and silicone rubber-coated glass cloths at lower temperatures, 225 C and 200 C.

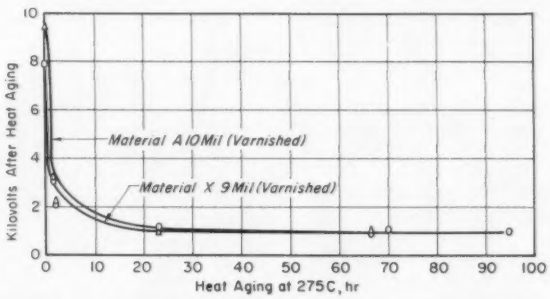


Fig. 9.—Effect of Heat Aging at 275 C on Wrapped-Bar Dielectric Breakdown of Silicone-Glass Material.

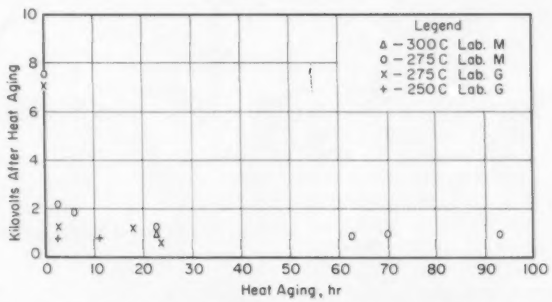
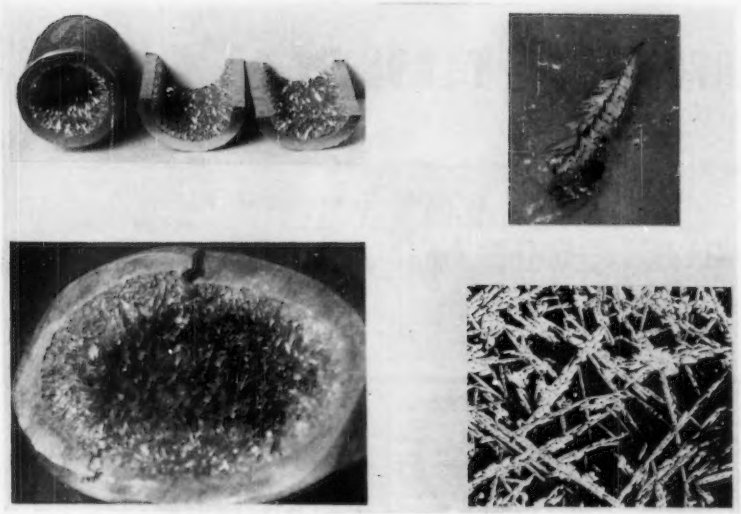


Fig. 10.—Effect of Heat Aging at Various Temperatures on Silicone-Varnished Glass x, 9 Mil; Wrapped Bar Method.

Summary

The Task Group has accomplished the following in the two years of its existence:

1. Clarified and crystallized the purpose of its program.
2. Organized an effective program to study two methods, the curved-electrode method and the wrapped-bar method.
3. Showed how the rank of materials as to thermal stability may change markedly depending on the end point chosen.
4. Obtained data showing that the wrapped-bar test is too severe on silicone-varnished glass cloth at temperatures 250 C and greater.
5. Developed plans for continued testing at lower temperatures which should enable a decision to be reached on the merits of the two methods being studied.

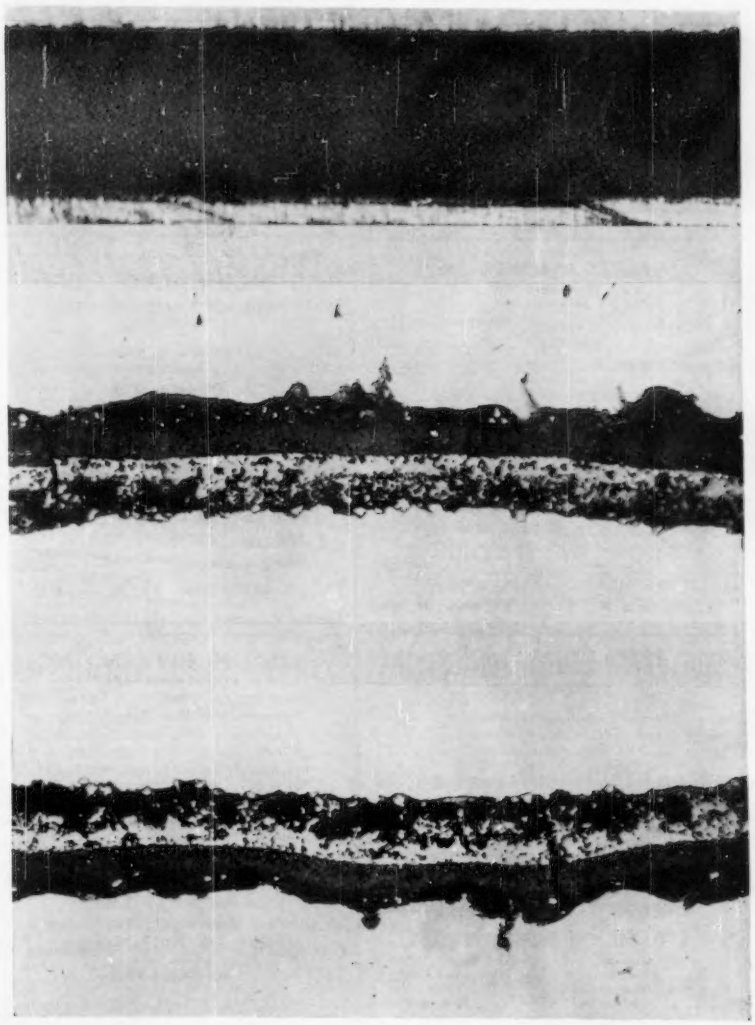


Metal Transport of Stainless Alloy by Liquid Lithium.

First Prize Macrographs—Tenth ASTM Photographic Exhibit. Mildred Ferguson, Babcock & Wilcox Co. Research Center, Alliance, Ohio.

The Case of the Mixed-Up Captions

The BULLETIN staff was obviously not watching the birdie when they affixed the wrong caption to the prizewinning photograph that appeared on page 26 of the February BULLETIN. The mix-up occurred through the fact that the prizewinning photographer, Mildred Ferguson of Babcock & Wilcox Co., won prizes in two categories at last year's Photographic Exhibit. Both her photographs appear here with their correct captions.



Water Corrosion Deposit Retained with Silver Foil as Back-Up Material.

Second Prize General Metallic Photomicrographs—Tenth ASTM Photographic Exhibit. Mildred Ferguson, Babcock & Wilcox Co., Research Center, Alliance, Ohio.

It is very difficult, if at all possible, to retain very soft, porous, and powdery deposits thoughout polishing procedures. By using silver foil as back-up material and minimum polishing time, this deposit of magnetic iron oxide and nickel oxide was successfully retained. Represents unusual technique.

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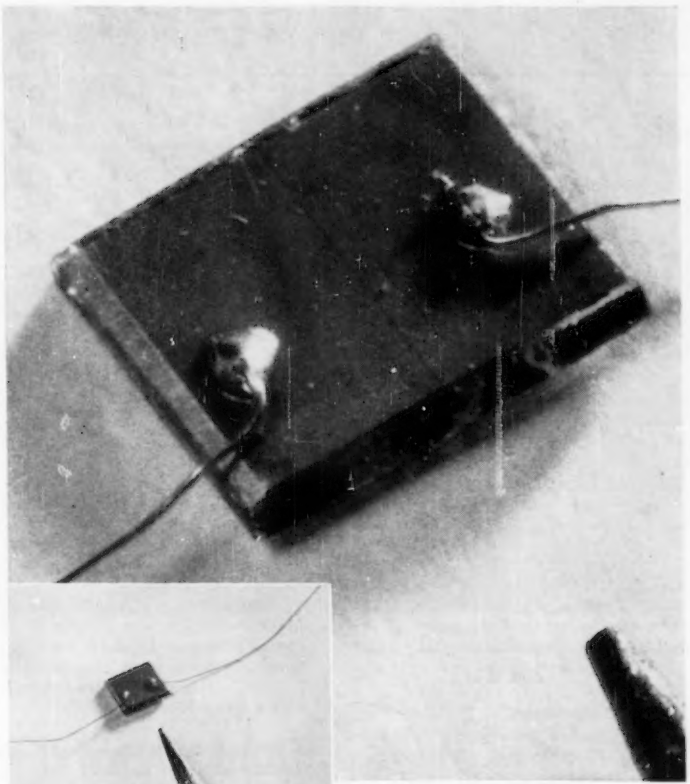
Kodak reports to laboratories on:

a photoresistor 20μ wide . . . a hydrocarbon among hydrocarbons



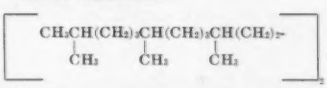
Thin receptor

The thin black line is 20μ wide and 0.2 mm long. In the dark, d-c resistance across the .0008″ of lead sulfide is a few hundred ohms. When radiant energy shines on the line, the resistance drops. A manifestation, obviously, of the celebrated *Kodak Ektron Detector*. The wavelength of the energy can be from 3.5μ in the infrared,* right through the visible and on to at least 250mμ in the ultraviolet. Imagine an infrared spectrometer that could afford to image its exit slit down to .0008″! Might provide some molecular structure data to think about. Or what about putting one in an image plane inside some optical system?

For $23.50, paid to Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y., anybody can have one. If the eloquence of these words gets us swamped, delivery may be a bit delayed. If you wanted to wait, it's not unlikely the price will drop. But then you might not be first on your block.

*That would make a receptor less than 6 wavelengths wide, wouldn't it?

That ol' shark oil



This looks like a tedious concatenation of 30 carbon atoms and 62 hydrogen atoms, but oh, how wrong you would be to say that!

This is *Squalane*. (Note the "a.") We hereby announce our readiness to sell it as Eastman 7311 at $15.60 per 100 grams. *Squalane* is hydrogenated *Squalene* (Eastman P6966). We can distill squalene (Note the "e.") in our unique molecular stills from the oil found in the gigantic, oily liver of the mighty but leisure-loving basking shark. Squalene is being added to at least one brand of cattle feed on the strength of certain findings by the manufacturer about cholesterol and sex hormones. The merest *soupçon* of it in dog food is said to bring utter bliss to the canine palate.

The latest is that *Squalane* has a contribution to make to gas chromatography, which is booming. This is an analytical technique whereby a volatile sample mixture is swept by an inert gas through an adsorbing column and resolved by virtue of the different times it takes each component to make its way through against the adsorption forces. *Squalane* is reported (*Anal. Chem. 28*,303, March '56) to modify the adsorbing characteristics of a commercial carbon black in a manner that shuffles the order of emergence from what it is with other adsorbents, thus providing a good fix on the proportions of each different C_6, C_6, and C_7 saturated hydrocarbon present. One of our own plants tried it out and forthwith contributed further to the burgeoning art by discovering that *Squalane* is very good at separating hydrocarbons from oxygen-bearing compounds close to them in physical properties. They found, for example, that n-heptane emerges later than n-butanol, even though n-butanol is the higher boiling substance.

Will we reveal more about this? Will other experiments now in progress with Squalane *turn out to be as interesting as the preliminary results promise? Don't wait for the next gripping chapter, if any. We sell* Squalane *with which you can go to work yourself. (You won't find it in our Eastman Organic Chemicals List, No. 40. It's too new. You will find some 3500 other organic compounds, though. If you haven't a copy, drop us a note.) Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).*

Prices quoted are subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are . . . *serving laboratories everywhere*

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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Robert F. Adams, formerly with the U. S. Bureau of Reclamation, Denver, Colo., is now senior materials and research engineer, California Department of Water Resources, Sacramento.

At the Mid-Winter Conference of the Texas Butane Dealers Assn. in Fort Worth in January, ASTM Director **R. C. Alden** (chairman, Research Planning Board, Phillips Petroleum Co., Bartlesville, Okla.) participated in a panel discussion based on an exhaustive report compiled by the Southwest Research Inst. of San Antonio, "Technological Audit and Economic Analysis of Liquid Petroleum Gases and Natural Gasoline," and the possible effect on the future of the retail fuel dealer of the rapid growth of the petro-chemical industry.

Robert C. Anderson, of Houston, Tex., until recently chief metallurgist at W-K-M Co., a Division of ACF Industries, announces that he has started the practice of consulting metallurgical engineering. He is now located at 7738 Park Place Blvd.

Herbert G. Arlt, Bell Telephone Laboratories, Murray Hill, N. J., has been elected president of the Standards Engineers Society. Mr. Arlt has been active for many years in a number of ASTM technical committees,

Alfred F. Arndt has retired as secretary, Humboldt Mfg. Co., Chicago, Ill. Mr. Arndt had been affiliated with ASTM for the past 35 years, serving on Committee E-1 on Methods of Testing.

Kenneth A. Arnold, technical director of central technical department of St. Regis Paper Co., has transferred from Deferiet to the New York City office.

Matthew J. Babey, formerly supervisor of fastness testing department, American Cyanamid Co., Organic Chemicals Div., Bound Brook, N. J., is now New York metropolitan sales agent for Atlas Electric Devices Co.

Howard S. Bean, chief of the Capacity, Density, and Fluid Meters Section of the National Bureau of Standards, received the Award of Merit of the Operating Section of the American Gas Assn. The honor recognized Mr. Bean's "continuous and extensive contributions to further the interests and promote the welfare of the industry and of the public to which it is dedicated." Mr. Bean serves on ASTM Committee D-3 on Gaseous Fuels, representing this group on Committees E-1 on Methods of Testing (Subcommittee on Glassware Laboratory Apparatus) and E-8 on Nomenclature and Definitions.

Merle E. Beige has retired as chief chemist, Esso Standard Oil Co., Pittsburgh, Pa. Mr. Beige has served for a number of years on Research Division XII on Graphite Tests of Committee D-2 on Petroleum Products and Lubricants.

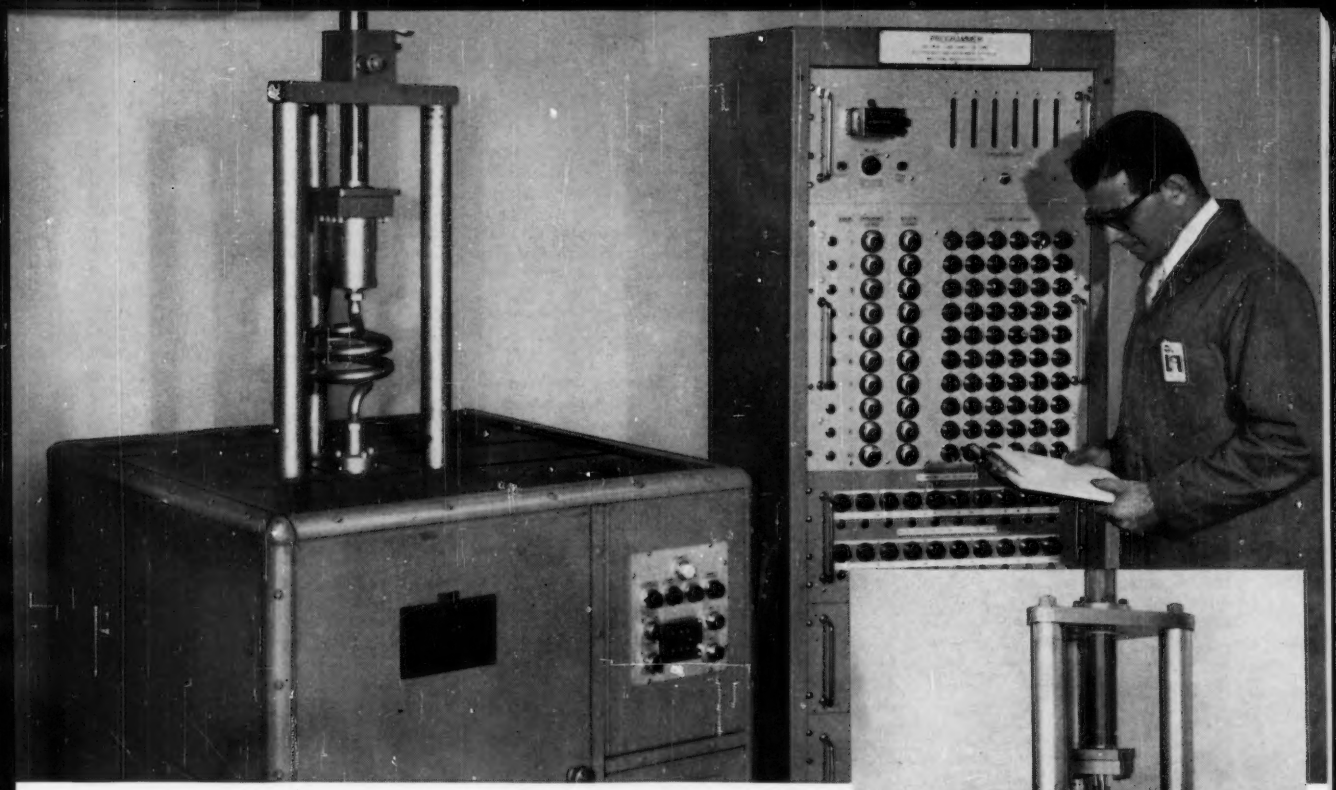
Joseph Bigos, formerly senior fellow, Mellon Institute, and director of research, Steel Structures Painting Council, Pittsburgh, is now head, Organic Coatings Section, U. S. Steel Corp., Applied Research Lab., Monroeville, Pa.

Arthur L. Brown has retired from active services as chief engineer and assistant manager, Factory Mutual Engineering Division, Norwood, Mass. Chairman of Committee E-5 on Fire Tests of Materials and Construction from 1948 to 1956, and active also in other committees of the Society, Mr. Brown plans to continue his ASTM affiliation. He resides at 90 Fenway, Boston, Mass.

ASTM Director **John M. Campbell,** who has been technical director, Research Laboratories Div., General Motors Corp., Detroit, Mich., since 1954, has been named scientific director; and in this newly created position will serve as principal assistant to Lawrence R. Hafstad, vice-president in charge of research.

Alfred L. Boegehold, until recently manager of research activities and principal assistant to Dr. Hafstad, and a member of the company research staff since 1920, has retired from active duties, but will continue to serve the company as a consultant. An ASM past-president, and honored otherwise by the American Society for Metals, also by the American Foundrymen's Assn., Mr. Boegehold is widely known for his technical achievements in metallurgy. Both Messrs. Campbell and Boegehold have been active in ASTM technical work, Mr. Campbell in a number of subgroups of Committee D-2 on Petroleum Products and Lubricants, and Mr. Boegehold for the past 30 years in various of the metals commit-

(*Continued on page 86*)



The Baldwin SF-1-U Universal Fatigue Machine shown here is being controlled by the Baldwin Programmer at its side. Entire sequences of varying static or dynamic loads can be run off, all in one automatic operation.

BALDWIN MAKES EVEN SEVERE, PROGRAMMED FATIGUE TESTS AN ACCURATE, AUTOMATIC OPERATION

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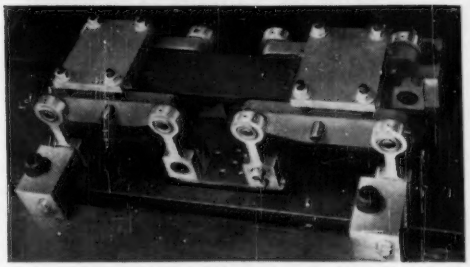
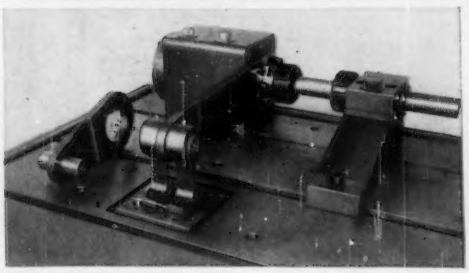
Add a Baldwin Programmer to your Baldwin SF-1-U Fatigue Machine, and you have testing automation! Complete test sequences can be set up on the programmer controls and run off on the fatigue machine without supervision. Varying static or dynamic loads for any predetermined number of cycles are possible. Loads can be changed at approximately 500 lb. per min.

For the best in testing, see Baldwin first . . . choose from a complete line of equipment for testing compression, tension, creep, fatigue, impact or torsion. Write today and ask to have a Baldwin representative call on you.

See Baldwin Fatigue Machines and the Baldwin Programmer at the Western Metals Show





Fixtures for Universal Fatigue Machines include (top to bottom) amplification, bending and torsion.

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FOR FURTHER INFORMATION CIRCLE 469 ON READER SERVICE CARD PAGE 121

Personals

(*Continued from page 84*)

tees. Mr. Boegehold resides at 3742 Erie Drive, Route 5, Pontiac, Mich.

Kenneth P. Campbell, works metallurgist for Sheffield Steel Div., Armco Steel Corp., Houston, Tex., has been named chairman of the Southwestern Section, Open Hearth Committee, American Inst. of Mining, Metallurgical and Petroleum Engineers.

Harold C. R. Carlson, design specialist, The Carlson Co., consulting engineers, New York City, and president of the Carlco Corp. of New York, specializing in international research on products, processes, and development, has been elected a Fellow of The American Society of Mechanical Engineers. Affiliated with a number of organizations, Mr. Carlson is a director of ASME and of the New York Chapter of Professional Engineers. In ASTM he has been active in Committee A-1 on Steel; also has been very active for many years in the work of the New York District Council, being a past-chairman of that group.

Robert H. Caughey has been named chief metallurgist for M. W. Kellogg Co., Jersey City, N. J.

The **University of Cincinnati** recently announced appointment of **Cornelius Wandmacher,** professor of civil engineering, as associate dean of the College of Engineering, effective September 1, 1957. Professor Wandmacher assumed the William Thoms professorship of civil engineering, the oldest chair in the University's College of Engineering, in September 1951.

George S. Cook, formerly with General Electric Co., Alkyd Resin Div., Schenectady, N. Y., is now chemist with Archer-Daniels-Midland Co., Minneapolis, Minn.

William A. Cordon, until recently research engineer, Portland Cement Assn., Chicago, Ill., is now associate professor of civil engineering, Utah State Agricultural College, Logan.

Marcel A. Cordovi, head of the materials and testing department, The Babcock & Wilcox Co.'s Atomic Energy Division, and metallurgical consultant to Brookhaven National Laboratory, was recipient of the second annual Industrial Achievement Award of the New York Chapter of the American Society for Metals. Born in Sofia, Bulgaria in 1915, he holds an AB degree from the American College at Sofia, BME, MME, and ME degrees from the Polytechnic Institute of Brooklyn.

Mr. Cordovi has been selected principal lecturer for a course on the metallurgy of nuclear power reactor materials slated for the spring semester of the Polytechnic Institute of Brooklyn. Mr. Cordovi has been very active in ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, serving as secretary for several years, and currently heading the subcommittee concerned with specifications for nuclear reactor structural materials. He also is a member of ASTM Special Administrative Committee on Nuclear Problems.

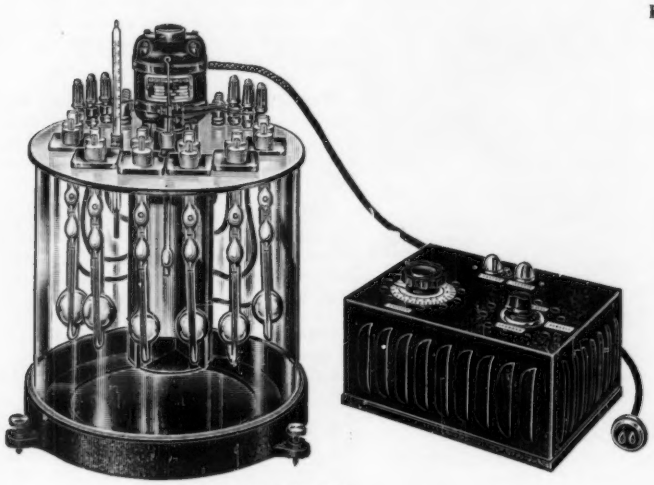
Robert E. Coughlan has retired as chief metallurgist and engineer of tests, Chicago & Northwestern Railway Co., Chicago, Ill. He is succeeded by **V. C. Barth,** who will represent the company in ASTM and on certain of the technical committees. Mr. Coughlan had represented C&NW for many years in the Society, serving on a number of the metals groups, also on Committees D-7 on Wood and D-13 on Textile Materials.

(*Continued on page 88*)

KREBS CONSTANT TEMPERATURE BATHS

K 1997

FOR USE WITH CAPILLARY VISCOMETERS
A.S.T.M. D 445-53 T



Patent No 2,227,938

A highly sensitive apparatus to hold constant temperature in any part of the bath within ±0.02°F. or better over the entire temperature range, from below room temperature up to 210°F., with water as the bath medium.

Accurate temperature control and positive heat distribution to all parts of the bath are obtained and maintained, by the Unique assembly of cooling and heating coils in the circulating tube that delivers the preheated bath liquid of the proper operating temperature to all parts of the bath not depending on the so called turbine stirrer for agitation.

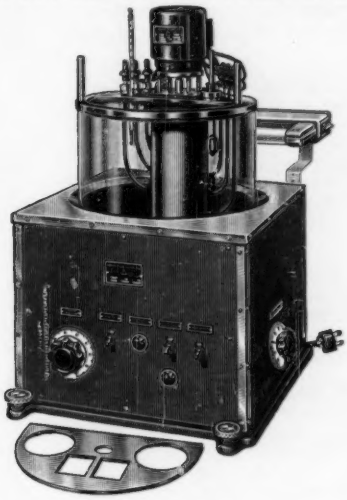
The sturdy apparatus is made of non corrosive materials, chromeplated.

Supplied as illustrated with (Electronic Control and Variable Transformer) to regulate the continuous heater. Any delicate thermoregulator can be used as the relay coil draws only a few micro amperes.

Complete with vapor type thermoregulator and six receptacles, Modified Ostwald or Ubbelohde, 115 to 220 Volts A. C. 60 or 50 Cycles. Other circuits on request. The same bath can be furnished for General Purpose use with a large semi-circular opening in bath top on which plates with openings to your specifications can be placed.

MID-CENTURY MODEL

FOR USE WITH CAPILLARY VISCOMETERS
A.S.T.M. D 445-53 T
STANDARDIZING THERMOMETERS
A.S.T.M. E 77-56 T
FOR ANALYTICAL AND RESEARCH WORK



Patent No. 2,227,938

A Constant Temperature Bath of Ultra Precision performance of ±0.01°F. with Vernier Control, actuated by a Quickset mercury in glass magnetic adjustment thermoregulator. Accurate temperature and positive heat distribution to all parts of the bath are obtained and maintained as in the K 1997 Bath by the Unique assembly of cooling and heating coils in the circulating tube that delivers the preheated bath liquid of the proper operating temperature to all parts of the bath and not depending on agitation.

The low temperature bath operates from below room temperature up to 210°F. with water as the bath medium. It is also available for temperatures up to 400°F. with oil. The combination Moat and Control Box housing the Electronic relay and adjustable transformers is of sturdy construction with heavy aluminum base, leveling screws, stainless steel top and corner trim. Front and back panels are removable for inspection of controls. It has a safety container that will hold the bath liquid in case of breakage of the Pyrex jar. The bronze chromeplated unit has a recessed top in which plates for Viscosity tube holders or racks for thermometer testing can be placed.

Supplied as illustrated with adjustable fluorescent light, 115 volts, 50 or 60 Cycle.

Racks for testing thermometers, also elevation brackets for the Pyrex jar when bath is used for Reverse Flow Viscosity tests, are available.

Do Not Confuse Baths of other make and similar description and appearance with
THE KREBS CONSTANT TEMPERATURE BATHS.

KREBS ELEC. & MFG. CO., INC. K E MFG **237-239 Lafayette St., N.Y. 12, N.Y.**

FOR FURTHER INFORMATION CIRCLE 471 ON READER SERVICE CARD PAGE 121

Personals

(*Continued from page 86*)

E. R. Crandall, until recently with The Mullite Refractories Co., Shelton, Conn., is now process engineer, American Refractories and Crucible Corp., North Haven, Conn.

A. T. Curtin has retired as manager of the Dade Testing Laboratory, Hialeah, Fla.

Michael Czuha, formerly on the research staff of Arnold O. Beckman, Inc., is now research chemist, Consolidated Electrodynamics Corp., Pasadena, Calif.

G. H. Dayett has retired as assistant to engineer of bridges and buildings, Baltimore & Ohio Railroad Co., Baltimore, Md.

Lewis Richard Davies-Graham, formerly with Swan Portland Cement, Ltd., Rivervale, Western Australia, is now manager, North Australia Cement, Ltd., Stuart, North Queensland.

Leon R. Eeman, until recently chief chemist, St. Lawrence Corp., Ltd., Red Rock, Ont., Canada, is now assistant technical supervisor, MacMillan & Bloedel, Ltd., Pulp and Paper Div., Port Alberni, British Columbia.

Hugo Filippi has retired as vice-president and secretary, Illinois Brick Co., Chicago, Ill. Mr. Filippi is continuing his ASTM membership, held since 1933. He resides at 11406 South Calumet Ave., Chicago.

Herman C. Fischer, formerly with New Jersey Zinc Co. (of Pa.), Palmerton, is now research engineer, Johns-Manville Research Center, Celite Dept., Manville, N. J.

Philip Fischer has accepted a position as spectroscopist with General Electric Co., Philadelphia, Pa. Previously he was with the Naval Air Engineering Facility, Aero, Materials Lab., NAES.

Stewart G. Fletcher, until recently director of metallurgy, has been elected vice-president of metallurgy, Latrobe Steel Co., Latrobe, Pa.

Carl F. Floe, professor of metallurgy and assistant provost at Massachusetts Institute of Technology, has been appointed assistant chancellor of the Institute.

J. V. Giesler has retired from active duty as president of Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville, Tenn.

Carl F. Graham has been appointed director of research and development, Turco Products, Inc., Los Angeles, Calif. He had been associated with Wyandotte Chemical Co., as supervisor of analytical research. Mr. Graham has been very active in Committee D-15 on Engine Antifreezes since 1950, serving efficiently as secretary of this main group. He also has served a term of two years on the Detroit District Council.

Raymond G. Hanson, formerly assistant editor, *Design News*, Rogers Publishing Co., Englewood, Colo., is now with Cooperative Wind Tunnel, Pasadena, Calif.

Carlton H. Hastings, formerly with the Watertown Arsenal, Watertown, Mass., is now with the Avco Manufacturing Corp., Research and Advanced Development Div., Lawrence, Mass.

Ernest O. Hausmann has been elevated to the office of vice-president of the Continental-Diamond Fibre Corp., Newark, Del.

R. C. Heaslett has retired as metallurgist, Blaw-Knox Co., Foundry and Mill Machinery Div., Coraopolis, Pa. Mr. Heaslett has represented his company on Committee A-1 on Steel for 20 years, also has served on Committee E-7 on Nondestructive Testing.

L. C. Hewitt, formerly director of research, has been elected vice-president of research and development, The Ironton Fire Brick Co., Ironton, Ohio.

L. F. Hickernell, chief engineer, Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y., was nominated for the office of treasurer of the American Inst. of Electrical Engineers.

J. Bennett Hill has retired as director, Research and Development Dept., Sun Oil Co., Philadelphia, Pa. Dr. Hill has represented his company's Sustaining Membership in the Society for many years, also has served on several subgroups of Committee D-2 on Petroleum Products and Lubricants.

T. F. Hindman has retired as manager of the Cleveland branch of the Pittsburgh Testing Laboratory. Robert J. Crouse is now PTL Cleveland district manager.

George F. Hodgson, since 1952 chief engineer at the Batavia, N. Y. plant, Doehler-Jarvis Division, National Lead Co., New York City, was named assistant chief engineer of the division at Toledo, Ohio.

William R. Holway, Tulsa (Okla.) consulting engineer who in 1929 surveyed a new water supply for Moscow, Russia, has been cited by Massachusetts Institute of Technology for "outstanding achievement and contributions to society." The MIT graduate has built water supply systems for Tulsa, Houston, and Santiago,

(*Continued on page 90*)

Personals

(*Continued from page 88*)

Chile, among others. His firm of William R. Holway & Associates is currently designing the proposed $34 million Markham Ferry dam and hydroelectric plant.

Alfred B. Howard has retired as chief gauger, Sun Oil Co., Marcus Hook, Pa.

H. Clay Howell is now on the staff of Miller-Warden Associates, Swarthmore, Pa.

C. E. Hrubesky of the U. S. Forest Products Lab., Madison, Wis., has retired. He had served on Committees D-6 on Paper, D-7 on Wood, and D-10 on Shipping Containers for many years.

Thomas A. Hunter, formerly on the technical staff, Bell Telephone Labs., Murray Hill, N. J., is now manager, Ampateo Laboratories, Cleveland, Ohio.

Morris L. Hutchens has been elected vice-president of engineering, Kearney & Trecker Corp., Milwaukee, Wis. He was formerly chief engineer.

Shigeo Kase, who recently received the degree of doctor of engineering in applied statistics concerning tensile strength of rubber at the University of Tokyo, has been named chief of the research department of Togawa Rubber Manufactory, Osaka, Japan.

Gerald V. Kingsley has been named director of research for Bohn Aluminum & Brass Corp., Detroit, Mich., replacing **William E. McCullough,** retired. Until his promotion he was chief metallurgist. Both Messrs. McCullough and Kingsley have been very active in a number of the metals committees of the Society for many years.

James D. Klinger is retiring from the Chemical Engineering Department, Chrysler Corp., Detroit, Mich. Mr. Klinger has been a member of the Society for more than 20 years, serving on Committees D-2 on Petroleum Products and Lubricants, and D-15 on Engine Antifreezes.

Don A. Lawless, until recently senior materials engineer, Electro-Mechanical Equipment, Jet Propulsion Lab., Sperry Rand Corp., Pasadena, Calif., is now materials engineer, Sperry Utah Engineering Lab., Salt Lake City.

William N. Lindblad, chief of Pacific Gas and Electric Co.'s Bureau of Tests and Inspection, Emeryville, Calif., has retired after 43 years of service. Mr. Lindblad who is a member of the Northern California District Council and has served on Committee D-9 on Electrical Insulating Materials, plans to continue his ASTM affiliation. He resides at 2230 Grant St., Berkeley, Calif.

William H. Lutz, who has been a vice-president of Pratt & Lambert, Inc., Buffalo, N. Y., since 1954, and who for more than 20 years has been technical director of the corporation's laboratories, has recently been elected a director of the company. Mr. Lutz has been active in ASTM work for many years, notably in Committee D-1 on Paint, Varnish, Lacquer, and Related Products; and is a former ASTM national director; also has served in numerous other capacities.

Albert G. Johnson, chief engineer, Omaha (Nebr.) Public Power District, was nominated as a vice-president of the American Inst. of Electrical Engineers for 1957–58.

Russell P. Mahan, secretary of the ASTM New England District Council, recently was made vice-president in charge of purchasing, Baird-Atomic, Inc., Cambridge, Mass.

William E. Mahin, former technical director of Vanadium Corp. of America and a management consultant, Cambridge, Ohio, has been elected president of the Malleable Research & Development Foundation.

J. E. Marian, formerly on the staff of Swedish Forest Products Research Lab.,

(*Continued on page 92*)

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FOR FURTHER INFORMATION CIRCLE 476 ON READER SERVICE CARD PAGE 121

Personals

(*Continued from page 90*)

Stockholm, Sweden, is now with the University of California, Forest Products Lab., Richmond, Calif.

Past-President **Harold L. Maxwell** has retired from the Engineering Division of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., after 27 years of service. Following Army service he returned to Iowa State College for graduate work and received his doctorate there. Then he was associate professor at Purdue University, at the same time doing consulting work; and in 1930 joined du Pont where he has had a distinguished record of service. He has written many articles and reports, and traveled very widely, speaking on technical subjects at engineering and scientific meetings. A longtime worker in the Society he served as ASTM President 1952–1953. He holds membership in many other organizations. Dr. Maxwell plans to maintain his home in Wilmington at 3206 Fordham Road.

Louis C. McCabe, president, Resources Research, Inc., Washington, D. C., and chairman of ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis, is program chairman for the Golden Anniversary meeting of Air Pollution Control Assn., to be held June 2–6, 1957 in the Jefferson Hotel, St. Louis, Mo. A recent release announced that four nationally recognized technical societies will join with APCA, Chairman McCabe hailing the presence of the American Meteorological Society, the American Society of Heating and Air Conditioning Engineers, the American Institute of Chemical Engineers and The American Society of Mechanical Engineers as a significant step in bringing together at *one* meeting information on air pollution control.

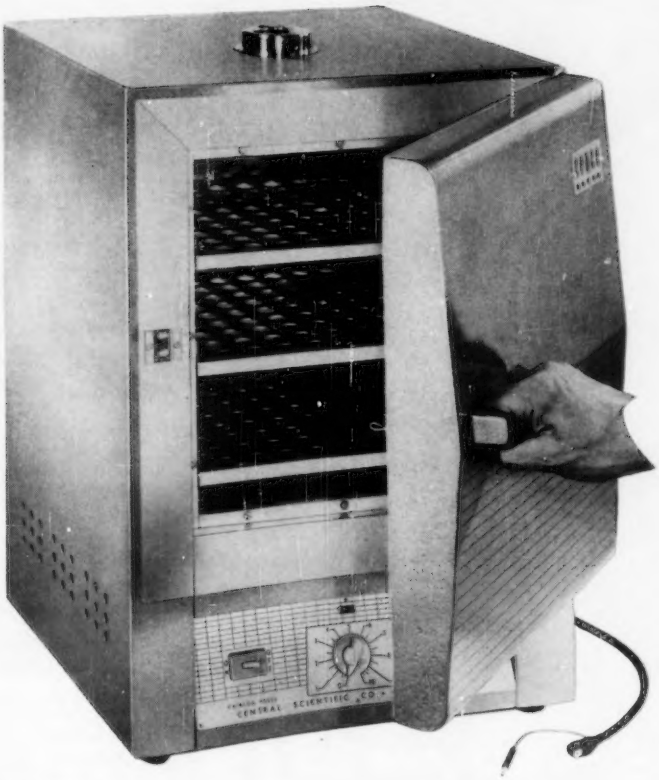
George E. Merkle, formerly vice-president and general manager, has been elected president, Fiske Brothers Refining Co., Newark, N. J.

Winford G. Milne has retired as chief engineer, N. Slater Co., Ltd., Hamilton, Canada. He is succeeded by **R. G. Baird.**

Stanley N. Mitchell has been appointed director of all geological and engineering geological activities in the firm of Maurseth & Howe, Los Angeles, Calif. **J. B. Howe** of the firm is secretary of the ASTM Southern California District Council.

A recent issue of *Metal Progress,* the very fine journal of our sister Society, the American Society for Metals, featured in its Biographical Dictionary of Eminent Living Metallurgists a good photograph and fine statement on **Norman L. Mochel,** Past-President of ASTM, and a constant contributor to both its research and standards work. Currently he is a Past-President on the Board of Directors (through 1958). In this tribute the

(*Continued on page 96*)



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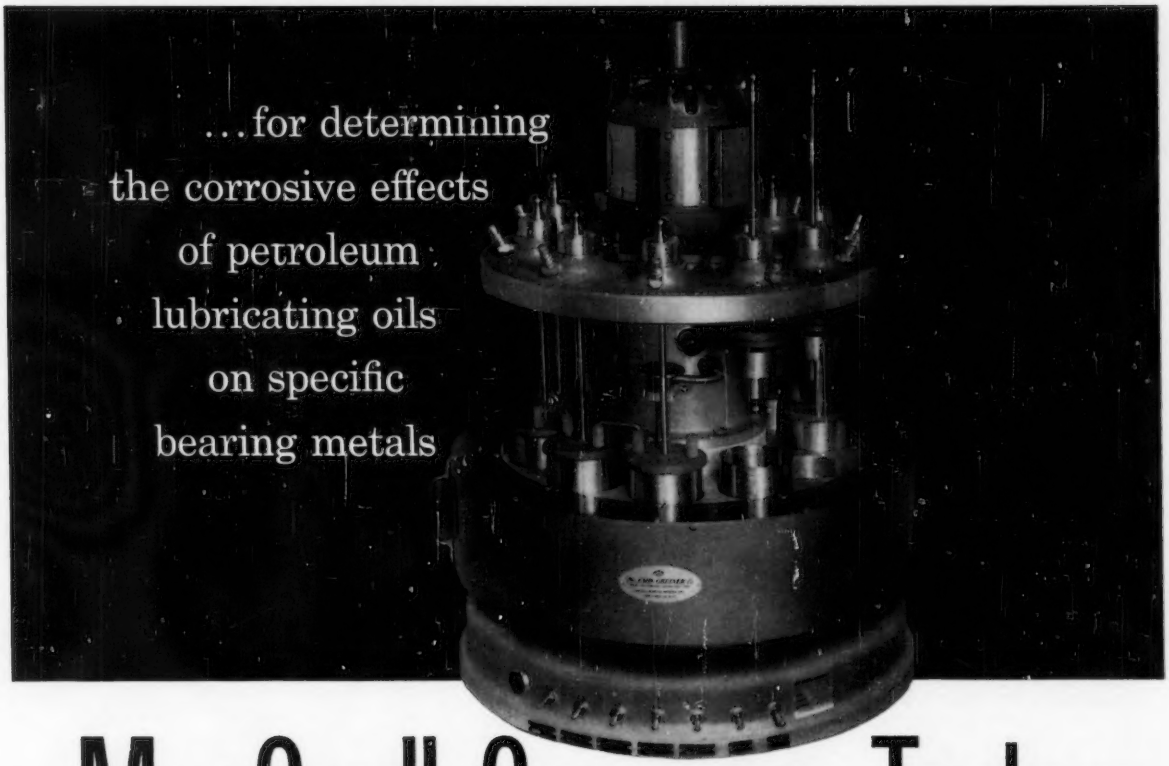

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The apparatus as illustrated is constructed of an aluminum block with ten beaker wells. Cartridge heaters are inserted into the bottom of the block for uniform heat distribution to each beaker well. The lead wires from the cartridge heaters run to a commutator plate between the heating block and the base block which permits rotating the heater block through an arc of approximately 350 degrees. Toggle switches inserted in the aluminum base plate operate the various banks of heaters, to obtain test temperatures of 350° F. In addition a thermoregulator circuit and relay control are also installed in the bottom compartment of the base. The top aluminum deck is equipped with a 1/3 horsepower heavy duty ballbearing motor which drives the ten test spindles through a belt and pulley arrangement. Each individual spinner is equipped with a ballbearing race and operates at a speed of 3000 RPM.

The assembly as illustrated comes complete with ten spinner assemblies, stationary baffle plates, split micarta bushings, stainless steel beakers, splash guard and beaker covers. Suitable for operation on 115 volts, 60 cycles single phase A.C.; current capacity 26 amp. Other voltages and frequencies to special order.

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G18733	Stationary base plate complete with copper baffles..... **each**	**$51.00**
G18734	Micarta beaker cover complete with splash guard and chimneys..... **each**	**$30.75**
G18735	Test bearings copper lead structure **each .35 per 100**	**$30.60**

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Personals

(*Continued from page 92*)

editors note that it is in ASTM that Mr. Mochel has found the greatest outlet for his talents. We are always pleased when other organizations who have shared the talents and energies of some of our distinguished members recognize the work they have done.

Accepting appointment as city engineer for Seattle, Wash., January 1, **Roy W. Morse** resigned his Washington, D. C., post as director of the technical review staff of the Department of the Interior. A native of Seattle, Mr. Morse returned to the city for which he was water superintendent for six years prior to the Washington, D. C., appointment. He succeeds **William E. Parker.**

John Marion Nagle, director of the Department of Public Works and Engineering for the City of Houston, was chosen Engineer of the Year by San Jacinto Chapter, Texas Society of Professional Engineers. The title was bestowed at a banquet at the Shamrock Hilton Hotel in February during National Engineers Week. ASTM President Schatzel and Executive Secretary Painter, on their Western trip, attended this function. Mr. Nagle, a registered professional engineer, has built bridges, dams, highways, electric interurbans, and blimp bases.

Wayne F. Nelson, formerly director of research, American Container Corp., Huntington, W. Va., is now with A. Schulman, Inc., Akron, Ohio, in the same capacity.

Robert Notvest has retired as chief chemist, National Bearing Div., American Brake Shoe Co., St. Louis, Mo. A member of the Society for more than 15 years, he had served on Committee E-3 on Chemical Analysis of Metals.

H. Thom Noyes, until recently assistant chief engineer, has been appointed chief engineer, Turner Construction Co., New York City, general contracting firm.

Graham L. Paterson, formerly mine surveyor, Eldorado Tennant Creek, Ltd., Australia, is now associated with Australasian Petroleum Co., Port Moresby, South Australia.

Charles F. Peck, formerly on the faculty of Carnegie Inst. of Technology, is now head of the Civil Engineering Department, The Cooper Union for the Advancement of Science and Art, New York City.

Lloyd M. Perry recently retired as chief chemist of Nashua Corp., Nashua, N. H. **Austin Davis,** director of laboratory, replaces Mr. Perry as representative of the Nashua company membership in the Society.

C. W. Phillips has accepted a position as supervisor, Reactor Materials Section, Ford Motor Co., Dearborn, Mich. He was previously assistant professor of metallurgy, University of Michigan.

Walter H. Price, head of the engineering laboratories, U. S. Bureau of Reclamation, Denver, Colo., was elected president of the American Concrete Inst. at the ACI annual convention in Dallas, Tex., in February. Active in ASTM technical work for many years, Mr. Price has been chairman of Committee C-9 on Concrete and Concrete Aggregates since 1954.

Daniel F. Reahard, until recently associated with Virginia Rubber Corp., Clifton Forge, Va., is now works manager, Wabash Rubber and Plastics Corp., Seymour, Ind.

Raymond C. Reese, consulting engineer, Toledo, Ohio, has been elected a director of the American Concrete Inst.

Frank W. Reinhart, chief, Plastics Section, National Bureau of Standards, received the Meritorious Service Award of the Department of Commerce "for major contributions to the science and technology of plastics and for highly distinguished authorship." Mr. Reinhart is chairman of ASTM Committee D-20 on Plastics and a past-chairman of Committee D-14 on Adhesives.

S. S. Rice has been named chief metallurgist of precious metals and stainless steel products division, J. Bishop & Co., Malvern, Pa.

John H. Romann has retired as chairman of the board of directors, The Prescot Co., Menominee, Mich. He had served for a number of years on Committee A-1 on Steel, also on ASA Sectional Committee B-36 on Standardization of Dimensions and Materials of Wrought-Iron and Wrought-Steel Pipe and Tubing.

Howard J. Rowe has been named chief metallurgist of the fabricating division, Aluminum Company of America, Pittsburgh, Pa. Operations of the castings division have been incorporated into the fabricating division.

Quentin Rust is now with Southern Peru Copper Corp., in Tacna, Peru.

Victor Siegfried, power cable engineer, Ansonia Wire & Cable Co., Ashton, R. I., was among sixteen electrical engineers and educators recently elevated to the grade of Fellow in the American Inst. of Electrical Engineers.

Henry R. Stevens, formerly with The Philip Carey Mfg. Co., Cincinnati, Ohio, is now on the engineering staff of Bird and Son, Inc., Norwood, Mass.

E. G. Sturdevant has accepted appointment as technical director, Kaiser Aluminum and Chemical Sales, Inc., Bristol (R.I.) Works. He was previously with United States Rubber Co., in the same city.

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Personals

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O. E. Sundstedt, a veteran of 26 years with General Foundry & Mfg. Co., Flint, Mich., has been named president of the firm.

J. E. Tiedt has retired as engineer of tests, Chicago, Rock Island, & Pacific Railroad Co., Chicago, Ill.

Thomas B. Tinney has retired as chief chemist, Philadelphia (Pa.) Gas Works Div., The United Gas Improvement Co. He is succeeded by **W. C. Powell.**

H. M. Truax, formerly with American Viscose Co., is now quality control manager, Atlas Powder Co., Wilmington, Del.

T. R. Truax has retired as principal wood technologist, U. S. Forest Products Laboratory, Madison, Wis. Affiliated with ASTM for many years, Dr. Truax has served on Committee D-7 on Wood, representing that group on the Subcommittee on Conditioning and Weathering of Committee E-1 on Methods of Testing. He resides at 3813 Council Crest, Madison, Wis.

Merritt A. Williamson, Dean of engineering and architecture at Pennsylvania State University, has accepted appointment as a member of the Pennsylvania Turnpike Commission.

Clyde H. Wyman, formerly with Burnside Steel Foundry Co., Chicago, Ill., is now manager of product development, Vulcan Steel Foundry Co., Oakland, Calif.

NEW MEMBERS . . . . . .

The following 225 members were elected from January 17 to March 13, 1957, making the total membership 8764 . . . . . Welcome to ASTM.

Note—Names are arranged alphabetically—company members first then individuals—Your ASTM Year Book shows the areas covered by the respective Districts

CHICAGO DISTRICT (5)

Blue M Electric Co., Angelo Lazzara, vice-president, 138th and Chatham Sts., Blue Island, Ill.

Butler, Walter, Co., Paul J. Liebelt, vice-president, 1300 Minnesota Bldg., St. Paul 1, Minn.

Ray-O-Vac Co., Morris R. Johnson, specifications engineer, 212 E. Washington Ave., Madison 10, Wis.

Birch, Lawrence Parr, consulting engineer, land surveyor, 616 Baum Bldg., Danville, Ill.

Bunce, Jerome R., supervisor, materials and product testing, The Bastian-Blessing Co., 4201 W. Peterson Ave., Chicago 30, Ill. For mail: 237 George St., Wauconda, Ill.

Busch, A. J., president, Charles C. Kawin Co., 431 S. Dearborn St., Chicago 5, Ill.

Elliott, Merle B., chief analysis engineer, Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., S., Minneapolis 8, Minn.

Epler, E. P., supervisor of service metallurgy, United States Steel Corp., 208 S. LaSalle St., Chicago 90, Ill.

Faist, Charles A., chief metallurgist, Burnside Steel Foundry Co., 1300 E. 92nd St., Chicago 19, Ill.

Hamel, Gayle E., engineering evaluation technologist, Minneapolis-Honeywell Regulator Co., 2600 Ridgeway Rd., Minneapolis 11, Minn. For mail: 1612 N. 6th St., Minneapolis 11, Minn. [A]*

Handy, Richard L., assistant professor of civil engineering, Iowa State College, Ames, Iowa. For mail: Box 71, Station A, Ames, Iowa. [A]

Holt, John Marshall, Department of Theoretical and Applied Mechanics, University of Illinois, 306C Talbot Lab., Urbana, Ill. [A]

Janesville, City of, Engineering Dept., Roger Krempel, assistant city engineer, City Hall, Janesville, Wis.

Kirby, Weymouth W., chief draftsman, Architectural Dept., Childs & Smith, 20 N. Wacker Dr., Chicago 6, Ill.

Krishock, Raymond A., materials engineer, Hotpoint Co., Division of General Electric Co., 227 S. Seely Ave., Chicago 12, Ill. [A]

Marshfield, City of, Engineering Dept., R. H. Schneider, city engineer, City Hall, Marshfield, Wis.

Meier, Don, specifications engineer, Viking Pump Co., Fourth and State, Cedar Falls, Iowa.

Morrow, JoDean, research associate, Theoretical Applied Mechanics Dept., University of Illinois, 321 C Talbot Lab., Urbana, Ill. [A]

Muelleman, J. P., chief inspector, materials, Chicago, Rock Island and Pacific Railroad Co., 4701 Wentworth Ave., Chicago 9, Ill.

Perkins, M. F., chief draftsman, Universal Oil Products Co., 30 Algonquin Rd., Des Plaines, Ill.

Pierce, Oliver F., plant chemist, Arizona Portland Cement Co., Rillito, Ariz.

Racine, City of, Engineering Dept., William J. Chadwick, city engineer, City Hall, Racine, Wis.

Richards, Chester J., metallurgist, The Clinton Machine Co., Maquoketa, Iowa.

Smith, Gordon W., sales engineer, Boston Gear Works, 14 Hayward St., Quincy 71, Mass. For mail: 479 Bluff City Blvd., Elgin, Ill. [A]

Wyckoff, Norman W., manager, product quality, Chicago Div., American Bosch Arma Corp., Chicago, Ill. For mail: 292 Blackhawk Rd., Riverside, Ill.

CLEVELAND DISTRICT (4)

Baker, R. M., chief metallurgist, Cleveland Diesel Engine Div., General Motors Corp., 2160 W. 106th St., Cleveland 11, Ohio.

Beach, O. M., president, The Frank L. Crobaugh Co., 3800 Perkins Ave., Cleveland 14, Ohio.

Clevenger, R. M., chief metallurgist, United States Steel Corp., Youngstown District, 912 Salt Springs Rd., Youngstown 9, Ohio.

Crouse, Robert J., Cleveland district manager, Pittsburgh Testing Laboratory, 1753 Chester Ave., Cleveland 14, Ohio.

(*Continued on page 100*)

* [A] denotes Associate member.
** [S] denotes Sustaining member.

New Members

(*Continued from page 98*)

Moore, P. E., assistant chief metallurgist, The Youngstown Sheet and Tube Co., Youngstown, Ohio.

Sexton, Harry, general supervisor (design), United States Steel Corp., 912 Salt Springs Rd., Youngstown 9, Ohio.

DETROIT DISTRICT (6)

Albert, Paul McHenry, partner, Albert & Knowles, 206 S. Main St., Ann Arbor, Mich.

Kirchner, Earl C., office engineer, American Louisiana Pipe Line Co., 645 Griswold St., Detroit 26, Mich.

Plummer, Paul A., head, Physical Testing Lab., Libbey-Owens-Ford Glass Co., Research Dept., 1701 E. Broadway, Toledo 5, Ohio.

Wolter, John U., supervisor, Control Labs., Wyandotte Chemicals Corp., Wyandotte, Mich.

NEW ENGLAND DISTRICT (13)

Bacon Felt Co., W. E. Becker, plant engineer, 427 W. Water St., Taunton, Mass.

Grant, Foster, Co., Inc., Ross H. Supnik, research group leader, 289 N. Main St., Leominster, Mass.

Premier Thread Co., W. Richard Mahoney, vice-president, Box 788, Pawtucket, R. I.

Anthony, Henry S., chemist, Tyer Rubber Co., Railroad St., Andover, Mass.

Ballass, John T., metallurgy section, Electric Boat Div., General Dynamics Corp., Groton, Conn.

Beebe, Fred, mechanical engineer, The Thompson & Lichtner Co., Inc., 8 Alton Pl., Brookline 46, Mass. For mail: B.O.Q. Navy 103, F.P.O., New York 1, N. Y.

Bolt, Thomas D., technical dept., Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass.

Chabot, Charles A., research director, Peters Manufacturing Co., 162 Old Colony Ave., Wollaston 70, Mass.

Emerson, Eliott Gould, president, Emerson Apparatus Co., 171 Tremont St., Melrose, 76, Mass.

Fulton, A. Oram, Jr., vice-president, Wheelock, Lovejoy and Co., Inc., 128 Sidney St., Cambridge 39, Mass.

Fuld, George J., instructor in biochemical engineering, Department of Food Technology, Massachusetts Institute of Technology, Cambridge 39, Mass. For mail: 120 Babcock St., Brookline 46, Mass. [A]

Graca, Adriano, Jr., mechanical engineer, Rodney Metals, Inc., New Bedford, Mass. For mail: 92 Dunbar St., New Bedford, Mass. [A]

Herbert, George E., chief chemist, Tyer Rubber Co., Railroad St., Andover, Mass.

Hunters, George A., Jr., manager, Testing Dept., Coats & Clark, Inc., Box 1000, Pawtucket, R. I.

Low, Sidney, chief of research and technical control, Chapman Valve Manufacturing Co., Pinevale St., Indian Orchard, Mass.

Stappenbeck, Karl, superintendant, Woonsocket Spinning Co., 115 Ricard St., Woonsocket, R. I.

Watters, B. G., engineer, Bolt, Beranek & Newman, Inc., 50 Moulton St., Cambridge 38, Mass.

NEW YORK DISTRICT (1)

Camden Wire Co., Inc., Lawrence A. Kent, assistant to the president, 12 Masonic Ave., Camden, N. Y.

Curtiss-Wright Corp., Industrial and Scientific Products Div., John C. Smack, manager of ultrasonic sales, Box 270, Caldwell, N. J.

Lycoming Div., Avco Manufacturing Corp., H. K. Adenstedt, staff engineer, Gas Turbine Dept., 550 S. Main St., Stratford, Conn.

Slide Faster Assn., Inc., Dwight M. Allgood, executive director, 60 E. 42nd St., New York 17, N. Y.

U. S. Industrial Chemicals Co., Division of National Distillers Products Corp., William C. Greenleaf, manager, metals sales and development, 99 Park Ave., New York 16, N. Y.

Blanchard, Yvonne, president, Manchard Trading Corp., 2315 Broadway, New York 24, N. Y.

Brownstein, Herman, plant engineer, Waterbury Garment Corp., 215 Cherry St., Waterbury 2, Conn. For mail: 141 Pine Ridge Rd., Waterbury 6, Conn. [A]

Camp, Eldridge K., staff engineer, component application engineering & technical services, International Business Machines Corp., South Rd., Poughkeepsie, N. Y. For mail: 207 Rochdale Rd., Poughkeepsie, N. Y.

Carson, Robert W., managing editor, Product Engineering, McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Cuthbert, Stuart V., chief metallurgist, American Machine and Foundry Co., Greenwich, Conn.

Davis, Edward J., research engineer, Johns-Manville Corp., Manville, N. J.

Gellis, Milton J. F., director, State Testing Laboratory, 226 Knowlton St., Bridgeport 8, Conn.

Gensamer, Maxwell, professor of metallurgy, Columbia University, 604 School of Mines, New York 27, N. Y.

Gimler, John R., physical test chemist, Hewitt-Robins Incorporated, Box A, Franklin, N. J. [A]

Heartel, Raymond H. W., chief metallurgist, Breeze Corp., Inc., 700 Liberty Ave., Union, N. J.

Jacobsen, Borge R., chemical engineer, F. L. Smidth and Co., Inc., 11 W. 42nd St., New York 36, N. Y.

Kertzman, J., consultant, 76 Oakwood Dr., Murray Hill, N. J.

Luckfield, William, foreman, Ink Dept., Western Printing and Lithographing Co., North Rd., Poughkeepsie, N. Y. For mail: 16 Lakeview Ave., Poughkeepsie, N. Y.

(*Continued on page 102*)

New Members

(*Continued from page 100*)

McCabe, Robert D., secretary, Underwear Inst., 468 Fourth Ave., New York 16, N. Y.

Meehan, Frank J., mechanical engineer, Materials Testing Lab., Johns-Manville Corp., Manville, N. J. For mail: 553 Howard Ave., Middlesex, N. J. [A]

Noble, Robert H., engineer, Perkin-Elmer Corp., Main Ave., Norwalk, Conn.

Noyes, H. T., chief engineer, Turner Construction Co., 150 E. 42nd St., New York 17, N. Y.

Parker, Edward F., standards engineer, Chemicals, General Electric Co., Engineering Standards Service, Bldg. 23, Schenectady 5, N. Y.

Raymer, Jack M., development engineer, Lycoming Div., Avco Manufacturing Corp., 550 Main St., Stratford, Conn. For mail: 65 Russell Rd., Milford, Conn. [A]

Robinson, Edward A., director of sales engineering, Expanded Aggregates, Inc., 40 W. 57th St., New York 19, N. Y. For mail: 416 Wilmot Rd., New Rochelle, N. Y.

Shera, Frank, executive vice-president, Magnesium Elektron, Inc., 630 Fifth Ave., New York 20, N. Y.

Smith, Ralph B., director, Department of Chemical Engineering, New Jersey Laundry and Cleaning Inst., 24 Lyons Ave., Newark 12, N. J.

Stiefler, Sidney, technical assistant, The Wool Bureau, 16 W. 46th St., New York 36, N. Y.

Warrick, Robert V., assistant utilization engineer, American Gas Assn., 420 Lexington Ave., New York 17, N. Y.

NORTHERN CALIFORNIA DISTRICT (8)

Hunnicutt, Richard P., head, metallurgy section, Aerojet-General Corp., Box 1947, Sacramento, Calif. For mail: 3132 Brophy Dr., Sacramento 21, Calif.

LaFrance, Paul E., sales engineer, Baldwin-Lima-Hamilton Corp., 2929 19th St., San Francisco 10, Calif.

Levin, Harry M., supervisor, Quality Control Lab., Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif. For mail: 13401 San Pablo Ave., San Pablo, Calif.

Meikle, James B., engineer, Raytherm Corp., 2821 Fair Oaks Ave., Redwood City, Calif.

San Jose Public Library, Geraldine L. Nurney, librarian, Market and San Fernando, San Jose, 13, Calif.

OHIO VALLEY DISTRICT (15)

Davis Fire Brick Co., Donald M. Rice, research director, Oak Hill, Ohio.

Drackett Co., The, F. E. Calvert, research director, 5020 Spring Grove Ave., Cincinnati 32, Ohio.

Kentucky Metal Products Co., James L. Covert, partner, 3104 S. Preston St., Louisville 13, Ky.

Bell, Arlen W., junior civil engineer, California Division of Highways, Bridge Dept., 3660 Wilshire Blvd., Los Angeles, Calif. For mail: 3325 Columbus Ct., Apt. 5, Columbus 9, Ohio. [A]

Glassford, J. H., research and technical director, Sheller Manufacturing Corp., Portland, Ind.

Hoffman, Russell, chief metallurgist, The Tool Steel Gear and Pinion Co., Elmwood Pl., Cincinnati 16, Ohio.

Holden, Frank C., assistant chief, Nonferrous Physical Metallurgy Div., Battelle Memorial Inst., 505 King Ave., Columbus 1, Ohio.

Leffel, John H., city engineer and county surveyor, Box 507, Mt. Vernon, Ind.

Spilker, Norman D., director of research, American Container Corp., 1111 Vernon St., Huntington, W. Va.

Story, Richard Neil, chemical engineer, Battelle Memorial Inst., 505 King Ave., Columbus 10, Ohio. For mail: 719 Harrisburg Pike, Columbus 23, Ohio. [A]

Taylor, M. Gibson, Jr., architect and civil engineer, 59 S. Main St., Winchester, Ky.

Wiegand, Vernon I. E., supervisor, nondestructive testing, General Electric Co., A.G.T. Div., Cincinnati 15, Ohio. For mail: 1943 Green Pine Dr., Cincinnati 31, Ohio.

PHILADELPHIA DISTRICT (2)

Greene, Tweed and Co., Agnes K. Potepan, chemist, Elm Ave., North Wales, Pa.

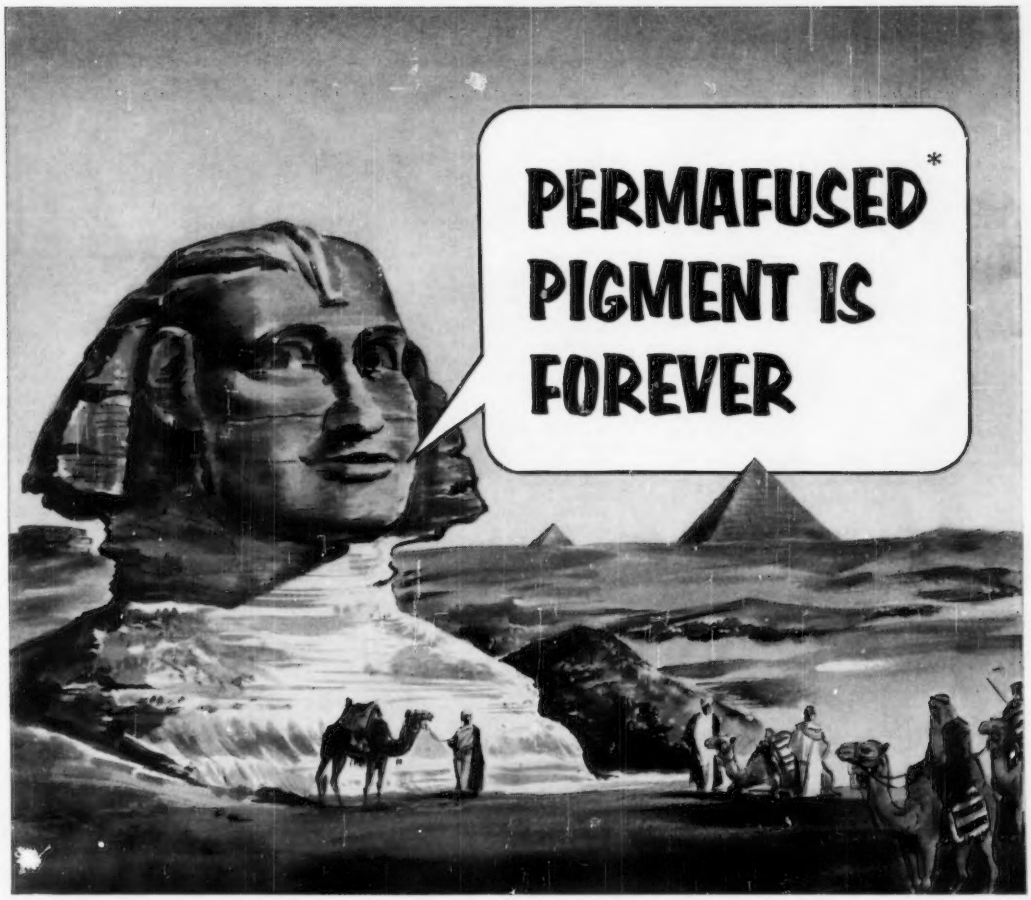
Beachum, E. P., assistant metallurgical engineer, Bethlehem Steel Co., 701 E. 3rd St., Bethlehem, Pa.

Beardsley, Herbert P., technical service representive, E. I. du Pont de Nemours and Co., Inc., Electrochemicals Dept., Wilmington 3, Del.

Benwell, Robert J., manager, C. H. Wheeler Co., Wheelerweld Div., S. Main St., Ambler, Pa.

Chalfant, William E., assistant manager, Product Control Dept., The Atlantic Refining Co., Box 8138, Philadelphia 1, Pa.

(*Continued on page 104*)



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FOR FURTHER INFORMATION CIRCLE 493 ON READER SERVICE CARD PAGE 121

New Members

(*Continued from page 102*)

Crits, George J., assistant technical director, Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia 34, Pa.

Federline, C. Donald, sales manager, Kontes Glass Co., Spruce St., Vineland, N. J.

Geddes, Edward, architect, 844 Montgomery Ave., Narberth, Pa.

Gehrm, John A., sales engineer, Kawecki Chemical Co., 220 E. 42nd St., New York 17, N. Y. For mail: 547 Lafayette Rd., Merion, Pa.

Kulp, Paul R., manager, physical testing, The Dentists' Supply Co. of New York, 550 W. College Ave., York, Pa.

Powell, W. C., chief chemist, Philadelphia Gas Works, Division of United Gas Improvement Co., 31st St. and Passyunk Ave., Philadelphia 45, Pa.

Taylor, William H., partner, Sherman, Taylor & Sleeper, 501 Cooper St., Camden, N. J. [A]

Wendt, Edward A., Morris-Wheeler and Co., 2500 E. Duncan St., Philadelphia 24, Pa. For mail: 1420 Chelten Ave., Philadelphia, Pa.

Wilson, Charles R., graduate assistant, Department of Civil Engineering, Fritz Lab., Lehigh University, Bethlehem, Pa. [A]

PITTSBURGH DISTRICT (3)

Sonneborn, L., Sons, Inc., Hans Schindler, manager, Daugherty Refinery Div., Petrolia, Pa.

Brown, M. J., chief specification metallurgist, Homestead District Works, United States Steel Corp., Munhall, Pa. For mail: 155 Roberta Dr., Pittsburgh 21, Pa.

Farmer, William A., commercial research analyst, United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.

Hoyer, Norman S., manager, research and development, Gibson Electric Co., 8350 Frankstown Ave., Pittsburgh 21, Pa.

Huber, W. R., assistant chief metallurgist, Johnstown Works, United States Steel Corp., 545 Central Ave., Johnstown, Pa.

Kreisberg, Sol, Jones & Laughlin Steel Corp., Metallurgical Dept., Aliquippa Works, Aliquippa, Pa.

Petty, Thomas W., packaging and loading engineer, United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.

Platte, Jerome A., Research Dept., Hagan Chemicals and Controls, Inc., 323 Fourth Ave., Pittsburgh 22, Pa.

Rector, William H., sales engineer, Arcweld Manufacturing Co., Liberty St. Extension, Grove City, Pa. For mail: 72 N. West St., Xenia, Ohio.

Snyder, Harry Z., customer service, Archeld Manufacturing Co., Box 311, Grove City, Pa.

ST. LOUIS DISTRICT (9)

Akers, C. E., plant engineer, The L.F.M. Manufacturing Co., Inc., Box 480, Atchison, Kans.

Barnes, Ira B., chief chemical engineer, Macon Arms, Inc., 800 E. Kenwood, Decatur, Ill.

Blum, Victor J., dean, Institute of Technology, Saint Louis University, 3621 Olive St., St. Louis 8, Mo.

Edmundson, Charles W., chief engineer, Stratford Engineering Corp., 612 W. 47th St., Kansas City 12, Mo.

Fell, Paul D., chief general engineer, Sinclair Pipe Line Co., Box 460, Independence, Kans.

Hatton, Roger E., Research Dept., Monsanto Chemical Co., 1700 S. 2nd St., St. Louis 4, Mo.

Huncke, Leslie W., president, William A. Smith Contracting Co., Inc., 1410 Fairfax, Kansas City 15, Kans.

SOUTHERN CALIFORNIA DISTRICT (7)

Hallamore Electronics Co., Frank D. Calkins, supervisor, electro-mechanical group, 8352 Brookhurst, Anaheim, Calif.

Litton Industries, 336 N. Foothill Rd., Beverly Hills, Calif. [S]**

Parsons, Ralph M., Co., The, E. William Van Ness, assistant chief engineer, 617 S. Olive St., Los Angeles 14, Calif.

Aldrich, Donald R., chemical engineering aide, reliability and standards, Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, North Hollywood, Calif. [A]

Biles, H. S., production engineer, Barton Instrument Corp., 580 Monterey Pass Rd., Monterey Park, Calif.

Brown, Thomas W., process analyst, Northrop Aircraft, Inc., Northrop Field, Hawthorne, Calif. For mail: 1623 W. 39th St., Los Angles 62, Calif.

Chalmers, Douglas, president, Golden State Rubber and Latex Corp., 1538 W. 132nd St., Gardena, Calif.

Deering, Mark F., structural engineer, 2236 Beverly Blvd., Los Angeles 57, Calif.

Dhein, Darryl D., junior engineer, Librascope, Glendale, Calif. For mail: 562 N. Avenue 23, Los Angeles 65, Calif. [A]

Ganoe, James R., Engineering Dept., California Spring Co., Inc., 8401 E. Slauson Ave., Rivera, Calif. For mail: 1432 S. Vermont Ave., Los Angeles 6, Calif.

Grebe, H. W., group engineer, Structural Materials, Lockheed Aircraft Corp., 1705 Victory Pl., Burbank, Calif. For mail: 1424 Bruce Ave., Glendale 2, Calif.

Hallin, Norman G., general manager, Saticoy Rock Co., Box 970, Ventura, Calif.

Holthaus, Warren E., associate engineer, Design, Douglas Aircraft Co., 3000 Ocean Park Blvd., Santa Monica, Calif. For mail: 2103 Midvale Ave., Los Angeles 25, Calif. [A]

(*Continued on page 106*)

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FOR FURTHER INFORMATION CIRCLE 496 ON READER SERVICE CARD PAGE 121

New Members

(*Continued from page 104*)

Horandt, Henry, Pacific coast manager, Neptune Meter Co., 5540 E. Harbor St., Los Angeles 22, Calif.

Jenkins, George L., member, Technical Staff, Hughes Aircraft Co., Culver City, Calif. For mail: 323 S. Helena St., Anaheim, Calif. [A]

Lauderback, Max, superintendent, Metallurgical & Inspection, Kaiser Steel Corp., Box 217, Fontana, Calif.

McCain, O. L., plant chemist, California Portland Cement Co., Box 126, Mojave, Calif.

McNerney, John, district engineer, Portland Cement Assn., 816 W. 5th St., Los Angeles 17, Calif.

Roberts, Howard E., general manager, Fairchild Electrotechnics, Division of Fairchild Engine and Airplane Corp., 118 E. 16th St., Costa Mesa, Calif.

Scherer, Wayne R., plant superintendent, Taylor Fibre Co., Box 99, Laverne, Calif.

Schott, R. A., head physical tester, California Portland Cement Co., Colton, Calif. For mail: Box 187, Highgrove, Calif.

SOUTHWEST DISTRICT (16)

Eastern States Petroleum Co., Inc., Frank Chairez, chief chemist, Box 5008, Harrisburg Station, Houston 12, Tex. [S]

Esso Standard Oil Co., Louisiana Div., E. M. Hattox, head, Petroleum Products Lab., Box 551, Baton Rouge 1, La.

Petro-Tex Chemical Corp., R. E. Hyzer, chief chemist, Box 2584, Houston 1, Tex.

Tellepsen Construction Co., J. L. Keith, vice-president, Box 2536, Houston, Tex.

Day & Zimmerman, Inc., G. J. Trump, director of inspection and quality control, Lone Star Ordnance Plant, Texarkana, Tex.

Beckham, Joe W., design engineer, Texas Foundries, Inc., Box 180, Lufkin, Tex.

Edmisten, Edward D., quality control manager, Fibercast Corp., 100 S. Lincoln, Sand Springs, Okla.

Girala, Anthony S., development engineer, F. H. Maloney Co., 2301 Texas Ave., Houston 1, Tex. For mail: Box 1777, Houston 1, Tex.

Heaney, Thomas D., consulting engineer, 2113 State St., Houston 10, Tex.

Jolley, James Lex, Jr., civil engineer, Gulf Interstate Gas Co., Box 1916, Houston, Tex. [A]

Smith, Cole, architect, 5622 Dyer St., Dallas 6, Tex.

Ubben, J. E., standardization engineer, American Petroleum Inst., 300 Corrigan Tower Bldg., Dallas 1, Tex.

WASHINGTON, D. C., DISTRICT (14)

Applied Physics Laboratory, The Johns Hopkins University, Manford B. Tate, structural engineer, 8621 Georgia Ave., Silver Spring, Md.

Brust, Stanley, engineer, Parsons, Brinkerhoff, Hall & MacDonald, 51 Broadway, New York, N. Y. For mail: 4 Acorn Ave., Hampton, Va. [A]

Cain, John Charles, president J. M. Cain and Co., Inc., Baltimore, Md. For mail: 412 Ambassador Apts., Baltimore 18, Md.

Chamblin, Brooke B., Jr., research engineer, Highway Research Council, Thornton Hall, University of Virginia, Charlottesville, Va. [A]

Curry, R. J., aircraft factory specialist, Civil Aeronautics Administration, 17th St. and Constitution Ave., Washington 25, D. C.

Evans, James V., director, asphalt research and development, American Oil Co., Box 1417, Baltimore 3, Md.

Faisant, J. L., president, J. L. Faisant and Associates, Inc., 2455 Maryland Ave., Baltimore 18, Md.

Feige, William C., Jr., partner, William C. Feige, Jr., and Co., 1120 N. Calvert St., Baltimore 2, Md.

Forrest, Alexander E., consulting engineer, 514 Park Ave., Baltimore 1, Md.

Kulp, J. Wesley, quality control supervisor, Catalyst Research Corp., 6101 Falls Rd., Baltimore 9, Md.

Obear, George H., soils engineer, J. E. Greiner Co., 1106 N. Charles St., Baltimore 12, Md. For mail: 301 Rossiter Ave., Baltimore 12, Md.

Seitz, Henry, structural engineer, The Baltimore & Ohio Railroad, 1301 Baltimore & Ohio Central Bldg., Baltimore 1, Md.

Teel, R. B., assistant manager, Kure Beach-Harbor Island Test Station, The International Nickel Co., Inc., Box 262, Wrightsville Beach, N. C.

WESTERN NEW YORK-ONTARIO DISTRICT (10)

Glidden Co., Ltd., The, F. L. Steele, technical director, 351 Wallace Ave., Toronto 9, Ont., Canada.

Hays, Manufacturing Co., Orlan French, chemical engineer, 801 W. 12th St., Erie, Pa.

Roxalin of Canada, Ltd., J. S. Hooper, chief chemist, Box 70, New Toronto 14, Ont., Canada.

Christian, Frank T., chief engineer, Eclipse Machine Div., Bendix Aviation Corp., Elmira, N. Y.

Ellmann, Leroy E., chemist, Keystone Chromium Corp., 1095 Niagara St., Buffalo 13, N. Y.

(*Continued on page 108*)

New Members

(*Continued from page 106*)

Harper, John S., laboratory technician, Twin Coach Co., Buffalo 25, N. Y. [A]
Hart, Donald M., chemist, Carbon Dept., Moore Business Forms, Inc., 3000 Highland Ave., Niagara Falls, N. Y.
Langan, E. J., general manager, Toronto Refiners and Smelters, Ltd., 28 Bathurst St., Toronto 13, Ont., Canada.
Parker, Charles J., research associate in physics, Corning Glass Works, Corning, N. Y.
Ray, Gerald J., general manager, American Resinous Chemicals of Canada, Ltd., 20 Trent Ave., Toronto 13, Ont., Canada.
Skelton, Herbert A., metallurgical engineer, The International Nickel Co. of Canada, Ltd., 25 King St., W., Toronto, Ont., Canada.
Wensing, Donald R., supervisor, Metallurgical Lab., Marlin-Rockwell Corp., 402 Chandler St., Jamestown, N. Y. For mail: 156 Martin Rd., Jamestown, N. Y.
Williams, Robert, quality control section, Engineering Dept., Instrument and Radar Div., Canadian Arsenals, Ltd., Box 256, Postal Station H, Toronto 13, Ont., Canada. For mail: 27 Luttrell Ave., Toronto 13, Ont., Canada.

U. S. AND POSSESSIONS

Floridin Co., G. C. Jones, sales engineer, Box 989, Tallahassee, Fla.
Northwestern Portland Cement Co., Gordon Tongue, president, 1702 Northern Life Tower, Seattle 1, Wash.
Bates, James P., chief metallurgist, Hyster Co., Box 4318, Portland 8, Ore.
Braznell, Charles W., estimator, Bradford Builders, Inc., 1101 Lincoln Road Bldg., Miami Beach, Fla.
Bunjer, J. A., chief engineer, Union Pacific Railroad Co., 1416 Dodge St., Omaha 2, Nebr.
Harris, William Stephen, II, engineer, Opelika Welding Machine and Supply, Inc., Box 310, Opelika, Ala. For mail: 104 N. 14th St., Opelika, Ala. [A]
Hogg, David J., executive vice-president, John J. Harte Co., Box 2192, Atlanta 3, Ga.
Hughes, Albert M., chemist, Rayonier, Inc., Olympic Research Div., Shelton, Wash.
Masuoka, Edward C., project officer, Company A, 802 Engineer Bn. (Hv. Cons.), APO 815, San Francisco, Calif. [A]
Pickering, Goebel B., supervisor, Fuels Section, Tennessee Valley Authority, 520 Power Bldg., Chattanooga, Tenn.
Rathburn, Robert C., partner, North American Inspection and Testing, 7708 Sixth Ave. N. W., Seattle 7, Wash.
Register, George R., partner, Haas, Register, Cummings & Hutchinson, 115 Park St., Jacksonville, Fla.
Shannon, Roy A., captain, Ordnance Corps., maintenance officer, U. S. Army Ordnance Depot Mainz, APO 185, New York, N. Y.
Wechsler, Kenneth, electrical engineer, Westinghouse Electric Corp., Micarta Div., Hampton, S. C.

OTHER THAN U. S. POSSESSIONS

B.S.A. Group Research Centre, D. A. Oliver, director of research, Mackadown Lane, Kitts Green, Birmingham 33, England.
Daimler-Benz A.-G., Stuttgart-Unterturkheim, Germany.
Industrial Engineering, Ltd., I. A. Usher, chief metallurgist, Box 70, Burnaby 1, B. C., Canada.
Bedding, W. C., owner, Koning & Bienfait, Box 6005, Amsterdam W. The Netherlands.
Bennell, Arthur, technical director, Central Electric Wire, Ltd., 18 Foster St., Perth, Ont., Canada.
Chiaraviglio, Sergio, general manager, Moto Mecanica Argentina S.A., 25 de Mayo 611, Buenos Aires, Argentina.
Park, Chyull Woong, president, Chosun University, Kwangju, Chollanamdo, Korea.

(*Continued on page 110*)

New Members

(*Continued from page 108*)

Coronado, Edgard, chemical engineer, Inst. Venezolano de Petroquimica, Caracas, Venezuela. For mail: URB 2 de Diciembre, Bloq. 13D, Apart. 54D, Caracas, Venezuela.

Cabello, J. R., director, Ministerio de Minas e Hidrocarburos, Centro de Evaluaciones, Caracas, Venezuela.

Desmarteau, Paul, certified technician, du Pont of Canada (1956) Ltd., Engineering Div., Box 660, Montreal, P. Q., Canada. For mail: 711 ave Le Laboureur, Boucherville, P. Q., Canada.

Eaton, Thomas David, research and development engineer, Humes, Ltd., 114 King St., Melbourne, Victoria, Australia.

Edmonton Public Library, Morton Coburn, chief librarian, McDonald Dr., Edmonton, Alta., Canada.

Ellis, Peter Edward, staff inspector, Naval Engineering Test Establishment, Box 1040, Montreal, P. Q., Canada.

Gunaji, Vasudeo N., civil engineer, 277 Thalakwadi, Belgaum, India.

Hutchings, F. G. B., city librarian, City of Leeds Central Library, Leeds 1, Yorkshire, England.

Institutionen för Förbränningsmotorteknik, Sven Lundberg, professor, Chalmers Tekniska Högskola, Gibraltarg, 5 M, Goteborg, Sweden.

Keller, Peter G., project engineer and senior specifications writer, Department of National Defence, Construction Engineering Dept., Air Force Headquarters, Bldg. 16, Victoria Island, Ottawa, Ont., Canada. For mail: Box 54, Station D, Ottawa, Ont., Canada.

Mattsson, Einar, doctor, AB, Svenska Metallverken, Västerås, Sweden. For mail: Gulsporregatan 4B, Västerås, Sweden.

Mehl, A. M., manager, Rhodesian Testing Laboratories, Sara House, Hatfield Rd., Salisbury, Southern Rhodesia, South Africa.

National Association of Testing Authorities, K. N. Stanton, deputy registrar, Fourth Floor, Kelvin Hall, 55 Collins Pl., Melbourne, Victoria, Australia.

Raes, G. A., Textile Lab., University of Ghent, St. Pietersnieuwstraat 59, Ghent, Belgium.

Reid, Norman L., director, Haddin, Davis & Brown, Ltd., 1134 Eighth Ave., W. Calgary, Alta., Canada.

Schmeicher, Herbert Miroslaw, chief designer, Letson & Burpee, Ltd., 172 Alexander St., Vancouver 4, B. C., Canada.

DEATHS...

S. W. Andrews, chief engineer, H. G. Acres & Co., Ltd., Niagara Falls, Ont., Canada (December 31, 1956). Representative of company membership since 1941.

F. W. Breth, vice-president in charge of manufacturing, L. Sonneborn Sons, Inc., Petrolia, Pa. (January 7, 1957). Member since 1923, serving for 20 years on Committee D-2 on Petroleum Products and Lubricants, and Subcommittees on Pharmaceutical Tests, Plant Spray Oil Tests, and Tests for Petroleum Sulfonates.

J. L. Broad, laboratory director, J. L. Broad and Associates, Fort Lauderdale Fla. (December 29, 1956). Member since 1953.

Harry D. Churchill, nationally known engineering consultant, author, and pro-

(*Continued on page 111*)

Deaths

(*Continued from page 110*)

fessor of engineering mechanics, Case Institute of Technology, Cleveland, Ohio; residence, 984 Cambridge Rd., Cleveland Heights (March 3, 1957). A member of ASTM since 1943, Professor Churchill had been a loyal supporter of the Society, and especially cooperative in the work of the Cleveland District Council, having served as vice-chairman of that group for the past four years. Born in Delevan, N. Y., Professor Churchill had received a professional civil engineering degree from Case. He was the first to win the Case Alumni Assn's. Meritorious Service Award for his devotion to Case students and their activities, for 36 years helping to shape their future. Affiliated with a number of technical organizations, he was serving as chairman of the Cleveland Chapter of the American Society for Metals at the time of his death.

Benedict T. Daly, analytical chemist, Material Testing Lab., City of Boston (Mass.) Public Works Dept. (March 15, 1956). Member since 1955.

Richard S. Dill, chief, Heating and Air Conditioning Section, National Bureau of Standards, Washington, D. C.; residence, 1603 S. Springwood Dr., Silver Spring, Md. (January 17, 1957). Member since 1948. Mr. Dill, who had been with the Bureau for 29 years, was nationally known as an expert in his field. Affiliated with many organizations he was vice-president of the American Society of Mechanical Engineers, past-president of the Washington Society of Heating and Air Conditioning Engineers, and member of the American Society of Refrigerating Engineers, Washington Academy of Sciences, and other groups.

F. G. Hechler, formerly on the faculty of The Pennsylvania State University, and recently of Yuma, Arizona (December 1, 1956). Professor Hechler had served for a long period as the University's representative on Committees C-16 on Thermal Insulating Materials, and E-6 on Methods of Testing Building Constructions, and in recent years as a consulting member of these groups.

H. H. Holmes, president, H. H. Holmes Testing Laboratory, Chicago, Ill. Member since 1948.

Charles C. Kawin, president and treasurer, Charles C. Kawin Co., Chicago, Ill. (January 26, 1957). Member since 1936.

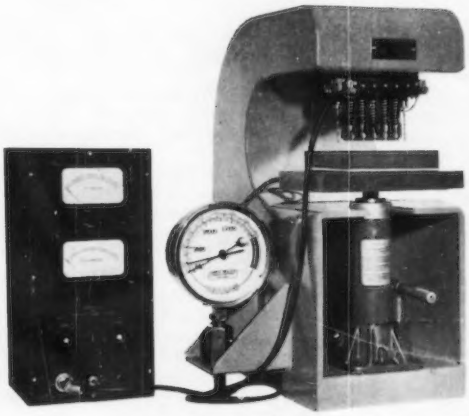
Frank P. Leahey, vice-president, Nichols Wire & Aluminum Co., Davenport, Iowa (December 27, 1956). Representative of company membership since 1948.

Eugene W. Morze, research director, X-Ray, Inc., Highland Park, Mich. (October 1, 1956). Member since 1952.

Rawson E. Stark, retired chief engineer, vice-president and director of Stupakoff Ceramic and Manufacturing Co.; recently consultant for the Stupakoff Division of The Carborundum Co., Latrobe, Pa. (January 19, 1957). Representative of company since 1946 on Committee D-9 on Electrical Insulating Materials, and its Subcommittee V on Ceramic Products. The holder of 30 U.S. and foreign patents, and active in scientific and technical organizations, Mr. Stark gave tirelessly of himself in promoting electrical progess.

Thomas B. Taylor, assistant to president, American Creosoting Co., Louisville, Ky. (May 13, 1954). Representative of company membership since 1941.

Samuel Weiss, executive secretary, American Coke and Coal Chemicals Inst., Washington, D. C. (November 17, 1956). Representative of Institute since 1949 on Committee D-5 on Coal and Coke, and since 1952 on Committee D-16 on Industrial Aromatic Hydrocarbons and Related Materials.



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CIRCLE 507 ON READER SERVICE CARD PAGE 121

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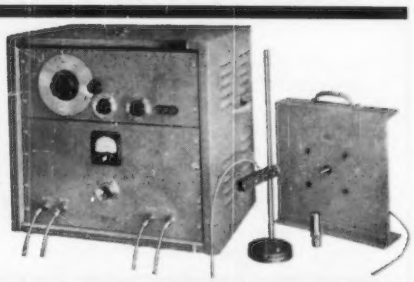

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CIRCLE 508 ON READER SERVICE CARD PAGE 121

Sargent
Constant Temperature Bath

The 0.01° C. Sargent Constant Temperature Water Bath, which is employed in many laboratories throughout the world where a precise, reliable thermostat is required, is now being supplied with an improved relay unit and heating system. The central heating and circulating unit of the bath is now equipped with three cylindrical heating elements rated at 200, 300 and 400 watts respectively. The 200 watt heater is controlled by the No. 81835 mercurial thermoregulator through a thyratron tube and saturable core reactor in the relay unit. (The use of a saturable core reactor obviates the difficulties commonly encountered with mechanical relaying systems such as pitted contacts, broken moving parts an freezing.) By means of a control mounted on the panel of the relay the output of this heater can be varied from the full 200 watts to approximately 60 watts, thus permitting such adjustment of the heater output that positive overshooting of the regulatory temperature is minimized. With the improved relay system this bath can be adjusted to a precision of ±.005° C. when operating in the vicinity of 25° C.

In addition, the relay unit is equipped with a master switch, a switch for each heater and a pilot light to indicate that the circuit to the 200 watt heater is closed.

Maximum power consumption 1100 watts. **S-84805** WATER BATH—Constant Temperature, 0.01° C., Sargent. Complete with Pyrex jar, 10 inches in diameter and 10 inches in height; central heating and circulating unit; constant level device; cooling coil; No. 81835 thermoregulator and relay unit with cord and plug for connection to standard outlets. For operation from 115 volt 50/60 cycle circuits **$300.00**

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SOUTHWESTERN DIVISION, 5915 PEELER STREET, DALLAS 35, TEXAS
SOUTHEASTERN DIVISION, 3125 SEVENTH AVE., N., BIRMINGHAM 4, ALA.

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NEWS NOTES ON
Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses. The society is not responsible for statements advanced in this publication.

LABORATORY ITEMS

Beakers—Beakers, now being molded from linear polyethylene and having a heat distortion temperature of 250 F, are now available.
American Agile Corp. 1313

Multipoint Recorders—Series 8000 Wheelco Electronic Multipoint Recorder can be used for the permanent recording of up to 16 points on one chart. It is a null-balance instrument.
Barber-Colman Co. 1314

Humidity Chamber—Automatically controlled two point programmer and recorder system for vapor-temp controlled relative humidity chamber meets MIL, JAN, ASTM and NEMA Humidity Cycling Tests.
Blue M Electric Co. 1315

Balance—A new type of microbalance has been announced. It is based on an application of Ampere's Law, in which sample weight is balanced by torque applied by an electric current in a magnetic field.
Cahn Instrument Co. 1316

Constant Temperature Ovens—A new line of constant temperature ovens featuring stainless steel interiors, controls mounted in the front where they are accessible, and other improvements, has been designed.
Central Scientific Co. 1317

Chilling Machine—A compact new chilling machine engineered especially for testing stability of electric wire insulation has been introduced.
Cincinnati Sub-Zero Products 1318

Vacuum Valve—A laboratory ultrahigh vacuum valve for handling pressures of 10^{-10} mm Hg and lower is now available.
Consolidated Electrodynamics Corp. 1319

Dial Indicator—Improvements in the design of the dial indicator calibrator add to making the unit easier to operate and increases the accuracy. The material of the housing is stress-relieved Meehanite in place of aluminum.
Custom Scientific Instruments, Inc. 1320

Measuring Magnifier—Used for on-the-spot checks for linear dimensions, diameters, radii, and angles. Linear dimensions are given both in inches and millimeters.
Edmund Scientific Co. 1321

DC Power Supply—A new d-c power supply with a specially designed front panel for rack mounting has been announced.
Electro Products Laboratories 1322

Manual Compactor—A hand-operated kneading compactor that can be used in the field as well as in the laboratory to produce soil and asphaltic-mix specimens large enough for pavement design purposes has been developed.
The Institute of Transportation & Traffic Engineering 1323

(*Continued on page 114*)

Laboratory Items

(*Continued from page 113*)

Graduated Cylinders—"Shellbach" graduations and lifetime blue-and-white striping are now available on a newly introduced line of Shellbach graduated cylinders.
Kern Laboratory Supply Co. 1324

Hardness Testers—New line of portable Brinell Hardness testers is available.
King Tester Corp. 1325

Rate of Pressure Changes—Rate of pressure changes can be measured directly with SLM Transducer system, Model PI-114. Utilizing the "electrostatic" principle, this instrument permits precision rate or dynamic pressure measurements.
Kistler Instrument Corp. 1326

One-Microsecond Decade—Model S-101 Decade is a one-microsecond scaling circuit designed for use in nuclear scalers and industrial counting equipment where extremely high speed and reliability is required.
Nuclear Instrument & Chemical Corp. 1327

Portable Survey Meter—A new portable survey meter with a variety of applications in industrial, medical, and research laboratories has been introduced.
Nuclear Measurements Corp. 1328

Brinell Hardness Tester—A new automatic go-no go Brinell Hardness Tester for production testing has been developed.
Tinius Olsen Testing Machine Co. 1329

Overpotential Testing—A nondestructive, very high potential unit is available for insulation testing of samples, or full reel tank testing. The unit offers a method of checking the insulation of cables and it meets new IPCEA standards as well as MIL, JAN and ASTM specifications.
Peschel Electronics, Inc. 1330

Versa-Tester—A multipurpose compression testing machine for research or routine laboratory testing is available.
Soiltest, Inc. 1331

Tension Testing—A hand-held meter which measures tape tensions for use with magnetic tape recorders has been released.
Tensitron, Inc. 1332

Immerex—For analysis of bituminous paving mixtures, a portable apparatus devised for laboratory or field use, for rapid, reproducible determinations of bitumen in hot or cold bituminous concrete samples up to 1000 g.
Arthur H. Thomas Co. 1333

Laboratory Press—Versatile press is furnished with adjustable speeds and adjustable pressure. The speed of the moving platen is variable from 0 to 170 in. per min closing and 0 to 87 in. per min opening.
Williams-White & Co. 1334

Temperature Controller—Precision electronic temperature controller, Model 63, improves regulation of calibrating baths, ovens, incubators, press platens, and many other processes by providing close on-off action.
Yellow Springs Instrument Co., Inc. 1335

CATALOGS AND LITERATURE

Data Systems—*Reprint R-98*, entitled "Increased Reliability of Industrial Data Systems," by L. M. Silva, B. K. Smith, and N. B. Braymer is available upon request.
Beckman Instruments, Inc. 2204

Analytical-Grade Ion-Exchange Resins—New folder, identified as Price List "M," contains—in addition to price information on analytical-grade ion exchange resins, cation exchange resins, and monobed resins—considerable additional data of potential value to the laboratory worker.
BIO-RAD Laboratories 2205

Recorders—A new six-page folder, illustrating and describing its direct writing recording systems, has been released.
Brush Electronics 2206

Briskeat Heating Tapes—Describes heating tapes for use in laboratories. Easily applied to shape or type of surface, the heating tapes are safe, quick heating and economical.
Burrell Corp. 2207

Paper Chromatography—New six-page booklet, *Bulletin #80*, lists the apparatus necessary for one and two dimensional paper separations and describes an instrument of wide d-c voltage range for electro-

(*Continued on page 116*)

NEW

FOR YOUR LABORATORY

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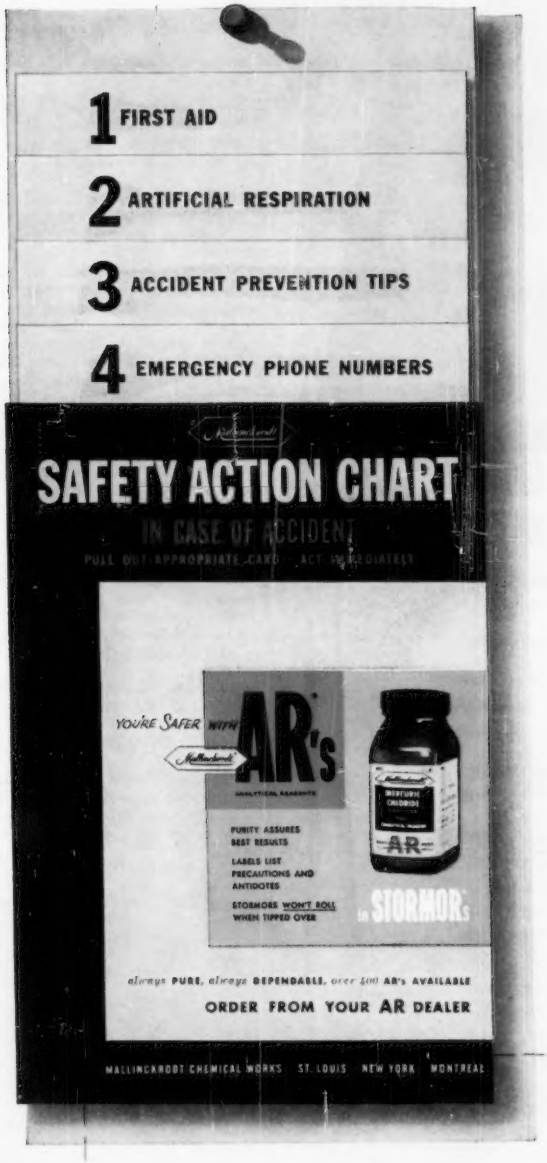

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FOR FURTHER INFORMATION CIRCLE 512 ON READER SERVICE CARD PAGE 121

Catalogs and Literature

(*Continued from page 114*)

phoresis measurements. Price information and dimensions for the equipment are also included.
Central Scientific Co. 2208

Bulletin No. 2—Price list for analysis of paints and lacquers is available.
Crippen & Erlich Laboratories, Inc. 2209

Electro-Mechanical Recorder—Data sheet describes ElectroSyn a nonelectronic signal generator system for the measurement, indication, transmission, and control of pressure, differential pressure, flow, liquid level, temperature, etc.
Detroit Controls Corp. 2210

Indicating Dynamometer—The new unit is comprised of a standard traction dynamometer, a pair of matched symchros and a remote case with a dial.
W. C. Dillon & Co., Inc. 2211

Computers—A new booklet, "High-Speed Analog Computers, Key to Rapid System Development," answers questions from engineers, and educators who are concerned with automation and the development of control systems for industrial and military applications.
GPS Instrument Co., Inc. 2212

Teflon Tubing—Teflon thin-walled tubing is the subject of a new 2-page bulletin, *Bulletin No. T-200.*
Haveg Industries, Inc. 2213

Bench Model Comparator—Literature illustrates Bench-Model SK-1003 Lead Comparator, has descriptive information and gives the range and accessories available.
Jerpbak-Bayless Co. 2214

Laboratory Glassware—Two newly imported lines of West German laboratory glassware are highlighted in a new inclusive catalog.
Kern Laboratory Supply Co. 2215

Ceramic Ware—Bulletin describes Zircon Ceramic Ware, including combustion boats, tubes and crucibles, combustion tube liners and thimbles, stock size tubes, incinerating dishes and custom-made ware.
Laboratory Equipment Corp. 2216

Resistance Thermometer—A new two-page *Data Sheet No. E-ND46(7)* describing the Speedomax G High Precision Resistance Thermometer Recorder is now available.
Leeds & Northrup Co. 2217

pH Electrodes and Mountings—This 4-page *Data Sheet No. N-S5(2)* presents engineering features and ordering instructions for dip-type immersion heads, continuous flow assemblies, and the new stainless steel mountings for pipeline pH measurements.
Leeds & Northrup Co. 2218

Environmental Test Equipment—Various types of environment simulation equipment made-to-order for military suppliers to meet their special test requirements are presented in a new four-page brochure.
Mantec, Inc. 2219

Radiation Gage—Data Sheet 10.9-3 describes the new Curtiss-Wright Radiation gage used with a Brown Electronik Strip Chart Recorder to make continuous noncontact measurement of weight per unit area of sheet.
Minneapolis-Honeywell Regulator Co. 2220

Pressure Transmitter—Specification S705-1 describes the Brown Non-Indicating Pneumatic Pressure Transmitter, for vacuum or pressure measurement.
Minneapolis-Honeywell Regulator Co. 2221

Directional Couplers—A new data sheet which covers the complete line of Narda 10, 20, and 30 db coaxial directional couplers, 225 to 4000 mc, has been published.
Narda Corp. 2222

Laboratory Instruments—*Catalog No. 57* lists a complete line of thermometers and hydrometers for science and industry. The catalog is illustrated with photographs and listings of all current ASTM thermometers and hydrometers and allied testing instruments.
Nurnberg Thermometer Co. 2223

Resistance Measuring Bridges—Seven bridges covering d-c resistance measurements from 1 micro-ohm to 1 million megohms to tolerances as close as 0.02 per cent are described in new bulletin, *Bulletin L-19B.*
Shallcross Mfg. Co. 2224

Magnets—Data sheet describes a horizontally rotating version of the Varian twelve-inch electromagnet.
Varian Associates 2225

Freeze Drying—New 18-page catalog describes fully the Vir-Tis Freeze Mobile, a complete, compact, and portable unit for freeze drying. Included also are infrared and roto-freeze units, a homogenizer, and various accessories.
Will Corp. 2226

INSTRUMENT COMPANY NEWS

Beckman Instruments, Inc., Fullerton, Calif.—The Scientific Instruments Div. has announced plans for a new $1,500,000 research and development building which will add 100,000 sq ft of working area to the present division plant and corporate headquarters in Fullerton.

The Budd Company, Philadelphia, Pa.—Tatnall Measuring Systems Co., a subsidiary of the Budd Co. has acquired United States and Canadian rights to Photo-Stress, a new stress analysis technique, from PhotoStress, Inc. of New York. PhotoStress uses conventional photoelastic methods for the experimental stress analysis of actual full size structures or components made of metal, concrete, wood, glass, plastic, rubber, stone or other structural materials, regardless of size or shape.

Davies Laboratories, Inc., Beltsville, Md.—Acquisition of all the stock of Davies Laboratories, Inc. by Minneapolis-Honeywell Regulator Co. marks an important milestone in the history of Davies and of magnetic tape data recording.

General Radio Co., Cambridge, Mass.—General Radio Co., electronic test equipment manufacturer, will begin construc-

(*Continued on page 118*)

ANDREX

announcement

Picker x-ray

Picker X-Ray Corporation and Holger Andreasen, Inc. are pleased to announce that, effective April 1, 1957, all Andrex equipment for industrial radiography will be distributed and serviced in the United States exclusively by Picker X-Ray Corporation.

The new arrangement will enable present and prospective users of Andrex equipment to share, jointly with users of Picker apparatus, the sales and technical facilities of the nationwide Picker engineering and service organization.

Inquiries may be directed to any local Picker office.

Or write to Picker X-Ray Corporation,
25 South Broadway, White Plains, N. Y.

Wherever you are, there's a Picker office somewhere near you in this network of sales and service facilities.

PICKER... one stop for everything in industrial fluoroscopy and radiography

ANDREX lightweight portable x-ray units—130 KV, 160 KV, 200 KV, 260 KV and *Androscope* X-ray Stress Analyzer.

PICKER x-ray units—5 to 50 KV, 150 KV (stationary and mobile), 270 KV portable, 260 KV heavy-duty, x-ray diffraction apparatus, rayproof inspection cabinets.

ACCESSORIES . . . films, tanks, darkroom sundries, illuminators, ***everything.***

TECHNICAL OPERATIONS units for isotope radiography—sources, equipment, containers for Iridium 192 Cesium 137 Cobalt 60 and Thulium 170.

FOR FURTHER INFORMATION CIRCLE 514 ON READER SERVICE CARD PAGE 121

Instrument Companies

(*Continued from page 116*)

tion in March of an 80,000 sq ft addition to its Concord, Mass. branch manufacturing plant.

Horizons, Inc., Cleveland, Ohio—The election of K. M. Bartlett as president of Horizons Inc., materials and process research organization of Cleveland, Ohio, and Princeton, N. J., has been announced.

Parr Instrument Co., Moline, Ill.—The company is pleased to announce the election of Manley R. Hoppe as president of the company to succeed Harold L. Parr who assumes a newly created office as chairman of the board of directors. Mr. Hoppe was formerly vice president of the firm. Frank P. Marquis, formerly secretary-treasurer, becomes vice president and treasurer. Willard A. Peterson has been elected secretary.

The Taft-Peirce Mfg. Co., Woonsocket, R. I.—A new Instrument Gage Div. has been established according to Vice President F. Steele Blackall, III. Taft-Peirce first entered the instrument gaging field in 1947. An Instrument Gage Department was subsequently organized to increase Taft-Peirce service to industry with a product line of air gaging and related equipment.

Testing Machines, Inc., New York, N. Y.—Testing Machines, Inc. proudly announces the acquisition of the testing machine division of the National Forge & Ordnance Co. This particular move rounds out the line of compression testers for flat, ring and Concora Liner Test as well as larger testers for 5000 and 10,000 lb compression of full containers.

NEWS OF LABORATORIES

Beckman Instruments, Inc., Fullerton, Calif.—Arnold O. Beckman, President of this company, and Louis D. Statham, President of Statham Labs., Inc., Los Angeles, jointly announced that agreement has been reached to merge the two multi-million-dollar firms, subject to the completion of legal details and the approval of shareholders.

Bowser-Morner Testing Labs., Inc., Dayton, Ohio—A spectrochemical laboratory service is now available and a special department is being completely equipped and fully staffed.

The Datics Corp., Fort Worth, Tex.—Datics Corp. was founded in Fort Worth, Texas to serve scientific and engineering fields with large scale computing, data processing, data reduction, and consulting and research in the field.

Desert Sunshine Exposure Tests, Phoenix, Ariz.—Announces the installation of an Equatorial Mount, intended to accelerate the effects of exposure to the sun and weather in Phoenix, Ariz. The device maintains its surface at normal incidence to the sun from sunrise to sunset.

Evans Research & Development Corp., New York, N. Y.—In a continuing program of expansion, Evans Research & Development Corp. has added five more members to its technical staff, according to an announcement by Eric J. Hewitt, vice-president of the New York City independent chemical consulting laboratory.

National Spectrographic Labs., Inc., Cleveland, Ohio—Glenn H. McIntyre, who for the past 30 years has been associated with the Ferro Corp., retired from his position as vice-president and technical director of Ferro in December, 1956, to assume active management.

Belgian Meeting on Scientific Research and Industry

On the occasion of the celebration of the centennial of its *Révue Universelle des Mines* the Association des Ingenieurs Sortis de l'École de Liège will hold an international meeting with the theme "Scientific Research and Industry" May 6 to 8, 1957.

The *Révue Universelle des Mines* is claimed to be the oldest Belgian technical publication and one of the oldest technical publications in the world.

Further information concerning the meeting may be obtained from Aristide Gillet, Le Secretaire General, A.I. Lg., 22, rue Forgeur, Liège, Belgium.

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Laboratory Items page 113

One sentence descriptions of new testing machines, laboratory or control apparatus, and related equipment.

Catalogs and Literature Section page 114

Charts, data sheets, catalogs, and other printed matter applicable to research, testing, or production control of engineering materials.

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200 mw over the range . . . G-R butterfly tuning unit avoids sliding contacts and other difficulties inherent in uhf tuning . . . ±1% frequency calibration; 10:1 slow motion drive . . . output through adjustable loop . . . audio modulation from external source; accessory Type 1000-P6 Crystal Diode Modulator permits video modulation with negligible incidental fm.

★ High Power Output ★ Simplicity of Operation ★ Wide Frequency Ranges ★ Low Cost

GR Unit Oscillators . . . covering the range from 20c to 7425 Mc . . . provide value per dollar difficult to match anywhere.

The fundamental task of signal generation is performed simply and well by instruments devoid of expensive frills. Sound electrical circuitry, incorporating only the essential features, makes them the equal in quality of any made by General Radio. Mechanical design emphasizes small size, light weight and basic miniaturization — the cabinets are about as small for heat developed within them as good engineering practice will allow.

The G-R UNIT INSTRUMENT concept provides flexibility as no other equipment does. One of the high-frequency Unit Oscillators, plus a Unit Power Supply, serves as an unmodulated general-purpose signal source having high-power output and good shielding. Add an audio fixed-frequency Unit Oscillator, and the assembly becomes a modulated power source. Add an attenuator, crystal rectifier, and a meter, and you have a standard-signal generator. Substitute a different high-frequency oscillator, and the system covers a new frequency range. At low frequencies, the addition of a Unit Amplifier gives more power.

Use of new G-R Sweep Drives adapts these manually-operated oscillators to automatic sweep applications. Accessory G-R attenuators, rectifiers, and modulators all may be used to contribute to the measurement at hand. There is no end to the assemblies and combinations possible — systems are easily extended to meet the requirements of new and different measurement problems with precision and economy.

Unit Oscillator	Frequency Range	Maximum Output/ Open Circuit Volts	Nominal Load Impedance	Additional Features
1210-B RC Oscillator, $165	20 cycles — 0.5 Mc (sine or square waves)	80 mw/7v 40 mw/45v 0-30v, p-p	500Ω 12,500Ω 2,500Ω	Multi-purpose lab signal source — 7v output, flat within ±1 db to 200 Kc; distortion less than 1.5%.
1214-A Unit Oscillator, $75	400, 1000 cycles (2 fixed frequencies)	200 mw/60v	8Ω or 30Ω grounded or ungrounded	Inexpensive fixed-frequency oscillator, has built-in power supply.
1211-B Unit Oscillator, $275	0.5–5 Mc 5–50 Mc	2 w 200 mw	50Ω	Compact, well shielded — frequency increments of 0.25% per division.
1215-B Unit Oscillator, $190	50–250 Mc	80 mw	50Ω	Semi-butterfly tuned circuit with no moving contacts.
1208-B Unit Oscillator, $200	65–500 Mc	100–500mw	50Ω	Very wide range in one band; thorough shielding.
1209-B Unit Oscillator, $235	250–920 Mc	200 mw	50Ω	Butterfly circuit avoids uhf tuning difficulties — excellent stability.
1218-A Unit Oscillator, $465	900–2000 Mc	200 mw	50Ω	Audio, pulse, square-wave or frequency modulation from external source.
1220-A Klystron Oscillator $205 without tube	8 Klystrons available 2700 to 7425 Mc range. $49.65 to $107.15	40 mw	50Ω	Compact, low cost microwave source — internal 1-kc square wave modulation; pulse or frequency modulation from external source.
1217-A Unit Pulser, $235	30 c — 100 kc (12 fixed frequencies)	20 v	200Ω positive pulses, 1500Ω negative pulses	Rise time, 0.05μsec-durations continuously variable 0.2 to 60,000μs.
1213-C Time/Frequency Calibrator, $195	5 Mc crystal provides 10 kc, 100 kc, 1 Mc, 10 Mc fundamentals and harmonics to 1000 Mc	10-30 v, p-p video output	cath. follower approx. 300Ω	Compact secondary frequency standard — accurate timing source for scope calibration, etc. — stability 1 ppm/°C after 1-hr. warmup.

★ Unit Instruments except 1214-A require Unit Power Supplies 1203-A Unit Power Supply, $40 — 1201-A Unit Regulated Power Supply, $85 1202-A Unit Vibrator Power Supply, $125, for operation from 6v or 12v storage battery

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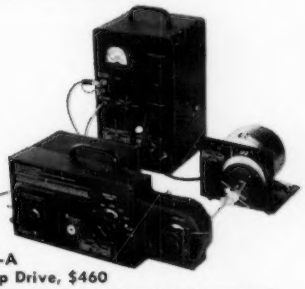

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. . . attaches to knobs, shafts or dials of a variety of equipment for automatic sweeping . . . Speed adjustable from 0.5 to 5 cps; Sweep Arc and Center Frequency also continuously variable . . . Type 1263-A Amplitude Regulating Power Supply, also shown, holds oscillator output constant as frequency is swept; Price, **$280**

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FOR FURTHER INFORMATION CIRCLE 520 ON READER SERVICE CARD PAGE 121

An OLSEN ElecΦmatic U.T.M.

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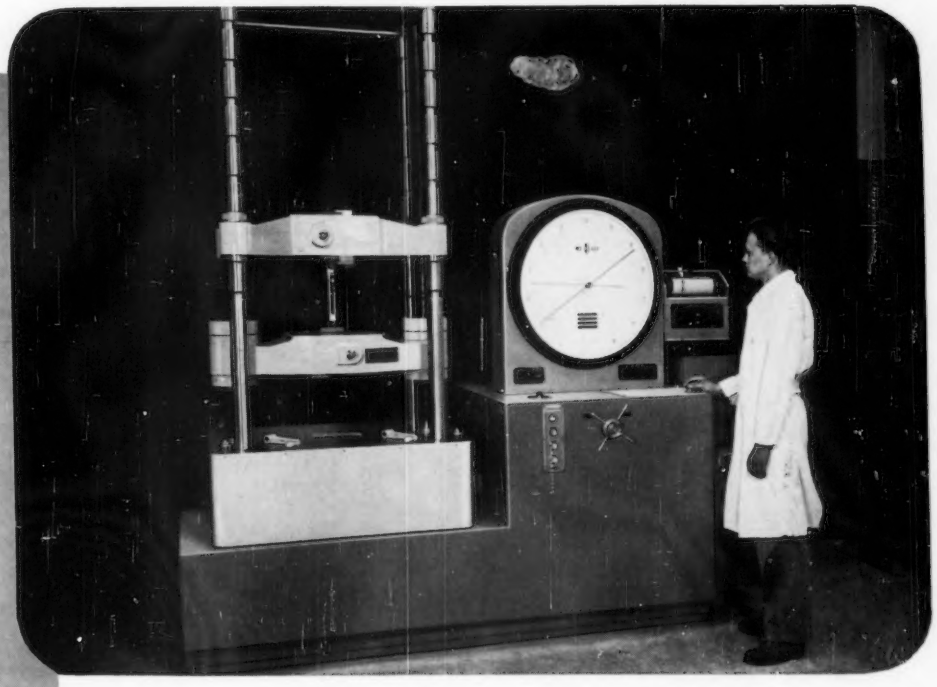

When tension, compression or transverse tests have to be made quickly and accurately, engineers in the Fritz Laboratory at Lehigh University can rely on this Tinius Olsen ElecΦmatic Universal Testing Machine.

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